The user manual is for GSK990MC Drilling and Milling Machine CNC System.

This manual describes the various matters concerning the operations of this CNC system as much as possible. However, it is impossible to give detailed descriptions to all the unnecessary or unallowable operations due to space limitation and product specific applications. Therefore, the matters not specially described herein should be considered as “impossible” or “unallowable”.

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Preface

Dear users,

It is our pleasure for your patronage and purchase of this machining center CNC system of GSK990MC Drilling&Milling CNC system produced by GSK CNC Equipment Co., Ltd.

This book is “PLC, Installation and Connection User Manual”, which introduces PLC programming method, installation and connection of GSK990MC.

To ensure the product works in a safe and efficient state, please read this manual carefully before installation and operation.

Warnings

Improper operations may cause unexpected accidents. Only those qualified staff are allowed to operate this system.

Special notes: The power supply fixed on/in the cabinet is exclusively used for the CNC system made by GSK.

It cannot be applied for other purposes, or else it may cause serious danger.

Declaration !

- We try to describe all the various matters as much as possible in this manual. However, it is impossible to give detailed descriptions to all the unnecessary or unallowable operations because there are too many possibilities. Therefore, the matters not specially described herein should be considered as “impossible” or “unallowable”.

Warning !

- Before installing, connecting, programming and operating the product, please read this manual and the manual provided by the machine tool builder carefully, and operate the product according to these manuals. Otherwise, the operation may cause damage to the product and machine tool, or even cause personal injury.

Caution !

- The functions and specifications (e.g., precision and speed) described in this manual are only for this product itself. For those CNC machine tools installing this product, the actual function configuration and specifications depend on the designs of the machine tool builders. Moreover, the function configuration and specifications of the CNC machine tool are subject to the manual provided by the machine tool builder.

All specifications and designs in this manual are subject to change without notice.

Safety notes

Transportation and storage

Do not pile up the packing boxes over 6 layers.

Never climb the packing box, neither stand on it, nor place heavy objects on it.

Do not move or drag the product by the cables connected to it.

Avoid impact or scratch to the panel and screen.

Packing box should be protected from dampness, insolation and drench.

Open-package inspection

Confirm the product is the one you purchased after opening the package.

Check whether the product is damaged during transportation.

Confirm all the elements are complete without damage by referring to the list.

If there is incorrect product type, incomplete accessories or damage, please contact us in time.

Connection

Only qualified personnel can connect and inspect the system.

The system must be earthed. The earth resistance should not be greater than 0.1Ω, and a neutral wire (zero wire) cannot be used as an earth wire.

The connection must be correct and secured. Otherwise, the product may be damaged or unexpected results may occur.

Connect the surge absorbing diode to the product in the specified direction; otherwise the product may be damaged.

Turn off the power before inserting or unplugging a plug, or opening the electric cabinet.

Troubleshooting

Turn off the power supply before troubleshooting or replacing components.

Overhaul the system when there is a short circuit or overload, and do not restart it until the trouble is removed.

Do not turn ON/OFF the product frequently, and the ON/OFF interval should be 1 minute at least.

Safety Responsibility

Manufacturer Responsibility

——Be responsible for the danger which should be eliminated on the design and configuration of the provided CNC systems

——Be responsible for the safety of the provided CNC and its accessories

——Be responsible for the provided information and advice

User Responsibility

——Be trained with the safety operation of CNC system operation procedures and familiar with the safety operation.

——Be responsible for the dangers caused by adding, changing or modifying the original CNC systems and accessories.

——Be responsible for the danger caused by failing to observe the operation, maintenance, installation and storage in the manual.

This user manual shall be kept by the end user.

Ⅰ Programming

Introduce the PLC specifications, addresses, base codes and functional code of GSK990MC CNC system.

Ⅱ Operation

Introduce PLC' operations of GSK990MC CNC system.

Ⅲ Function

Introduce the main function of GSK990MC CNC system.

Ⅳ Installation and Connection

Introduce the installation, connection and setting methods of GSK990MC CNC system.

Appendix

Introduce the usage of GSK990MC CNC system matched with a servo turret.

Safety responsibility

Manufacturer Responsibility

——Be responsible for the danger which should be eliminated on the design and configuration of the provided CNC systems.
——Be responsible for the safety of the provided CNC and its accessories
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User Responsibility

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——Be responsible for the danger caused by failing to observe the operation, maintenance, installation and storage in the manual.

This user manual shall be kept by the end user.

Thank you for your kind support when you are using the products of Guangzhou CNC Equipment Co., Ltd.

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Ⅰ Programming

Chapter 1 Sequence Program Creating Process

1.1 GSK990MC PLC Specification

GSK990MC PLC is shown below:

Table 1-1-1

Specification	**GSK990MC PLC**
Programming language	Ladder
Program level	2
The 1st level program execution cycle	8ms
Basis code average treatment time	5μs
Programming capacity	4700 steps
Code	Basis code + function code
Internal relay (R) PLC alarm detection (A) Nonvolatile memory area Timer (T) Counter (C) Data base (D) Nonvolatile relay (K) Counter prevalue data register (DC) Timer prevalue data register (DT) Subprogram (P) Mark (L) Input signal of NC side (F) Signal outputs to the NC side (G)	0~511 (byte) 0~31 (byte) 0~127 (word) 0~127 (word) 0~255 (word) 0~63 (byte) 0~127 (word) 0~127 (word) 0~99 0~99 0～63 (byte) 0～63 (byte)
I/O module (X) (Y)	0~63 (byte) 0~47 (byte)

1.2 What is a Sequence Program

The programming is performed a logic control to the machine tool and its relative equipments, which is called sequence programming.
After the programming is converted into some kind of format, CPU can be performed the code and calculation treatment for it, and its fruits can be memorized to RAM. CPU can be rapidly read each code stored in the memory, which can be performed the programming according to the calculation operation.
The compiling of the sequence programming starts with developing of the ladder diagram.

1.3 Distribution Window (Step 1)

The window can be distributed after confirming the controlled object and calculating the points of the corresponding input/output signal.
Refer to the Chapter Four Input/output window signal table in the part of the Installation and Connection when distributing the window.

1.4 Ladder Diagram Programming (Step 2)

GSK990MC ladder diagram is not permitted by an on-line modification but is edit by the software Lad Edit.exe on the computer. The control operation required by the machine tool can be expressed by the ladder diagram. The functions, such as the timer and counter, can not be expressed by relay symbols, which can be indicated by the specified function code symbols.
The compiled ladder diagram should be upgraded to the system.

1.5 Sequence Programming Debugging (Step 3)

The sequence programming can be debugged using the following methods:
1) Debugging with emulator
The machine tool can be replaced by an emulator (it composes of the lights and switches). The input signal state of the machine tool can be expressed by the ON or OFF of the switches; and the output signal state can be indicated by the ON or OFF of the light.
2) Debugging with actual operation
Debug on the actual machine tool. It is better to prepare the precautions before debugging, due to an unexpected behavior may occur.

Chapter 2 Sequence Program

The operating principle is different with the common relay, because the PLC sequence controlling is carried out by the ladder digram Lad Edit.exe compiling.

And therefore, it is better to thoroughly understand the sequence controlling principle when designing the PLC sequence programming.

2.1 Performance Process of Sequence Programming

In the general relay controlling circuits, each of them can be simultaneously operated. When the relay A is operated in the following figure, the replay D and E can be operated (when the contactor A and B are closed) at the same. Each replay in the PLC sequence control is operated in turn. The relay D is operated before relay A, and then the relay E operates (refer to the following figure). Namely, each relay is operated based upon the sequence of the ladder diagram (compiling sequence).

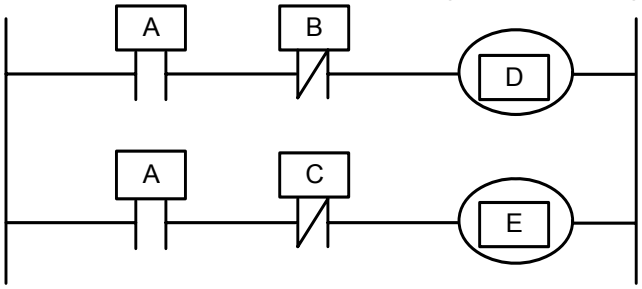


Fig. 2.1 (a) Circuit illustration

The differences between the relay circuit and PLC programming operation are shown below in the Fig. 2.1 (b) and Fig. 2.1 (c).

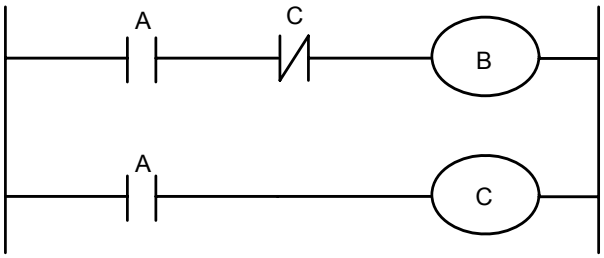


Fig. 2.1 (b)

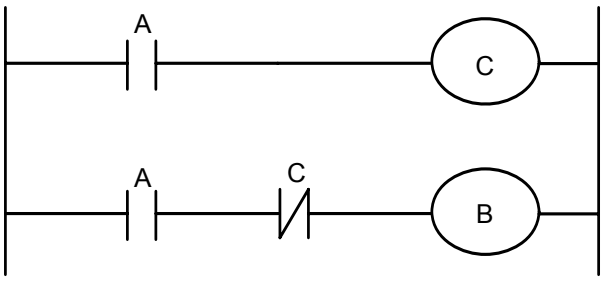


Fig. 2.1 (c)

(1) Relay circuit

Both Fig. 2.1 (b) and Fig. 2.1 (c) are shared a same operation. B and C are switched on after A is turned on. B is cut off after C is ON.

(2) PLC program

A same relay is shared a same circuit, refer to the Fig. 2.1 (b); B and C are switched on after A is turned on. B is cut off after one cycle of the PLC program is performed. In the Fig. 2.1 (c), C is ON instead of B, after C is turned on.

2.2 The Performance of the Cycle

PLC performs from the beginning to the end of the ladder diagram. It performs again from the beginning of the ladder diagram after this diagram is performed, which is called cycle performance.

The performance time from the beginning to the end of the ladder diagram is abbreviated as a period of a cycle treatment. The shorter of the treatment period is, the stronger of the response capacity of the signal is.

2.3 The Priority Sequence of the Performance (the 1st Level, the 2nd level)

GSK990MC PLC program are composed of two parts: the 1st level program and the 2nd level program, which are inconsistent with the performance period.

The 1st level program performs once each 8ms, which can be treated some fast corresponding and short pulse.

The 2nd program performs once each 8*nms. N is the partition value of the 2nd level program. PLC may divide the 2nd level program into N parts when the 2nd level program is executed. It is performed one part for each 8ms.

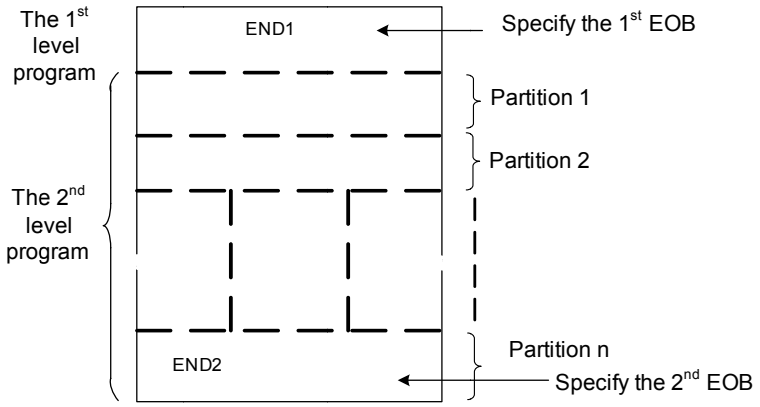


Fig. 2-3-1

PLC in the GSK990MC is separately performed in the PLC-AVR SCM. The 1ms of each 8ms is the communication time for reading the PLC data from the CNC. The 5ms is that the PLC gains the system control signal (F. X), and uploads the control result data (G, Y parameter) external port I/O. PLC is always performed the ladder diagram calculation other than the interruption of the response exchange data.

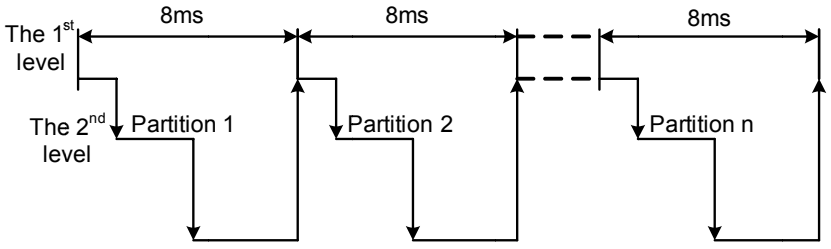


Fig. 2-3-2

When the last partition value of the 2nd level program of the n is performed, the program is then executed from the beginning of the program. In this case, when the partition value is n, the performance time of one cycle is 8*n ms. The 1st level program performs once each 8ms; the 2nd level program performs once each 8*n ms. If its steps of the 1st level program is increased, and therefore

the steps of the 2nd level program within 8ms should be reduced correspondingly; the partition value may be increased, and the treatment time of the overall program will be longer. So, the compiling of the 1st level program should be shorter.

2.4 Sequence Programming Structure

The ladder diagram is compiled with sequence in the traditional PLC. It owns the following advantages in the ladder diagram language allowing the structured programming:
1. The program is easy to comprehend and compile.
2. It is more convenient to find the faults during the programming.
3. It is easy to find some reasons when the operation malfunction occurs.

The methods of the main structure programming are shown below:
1) Sub-program
The subprogram is regarded as a treatment unit based on the ladder diagram.

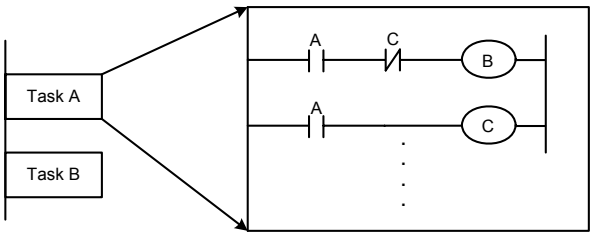


Fig. 2-4-1

2) Nesting
One subprogram can be performed the task by calling another one.

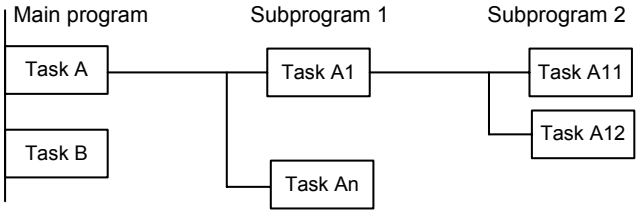


Fig. 2-4-2

3) Conditional branch
The main program is performed circularly, and checks whether its conditions are suitable. The corresponding subprograms are performed under these conditions, vice versa.

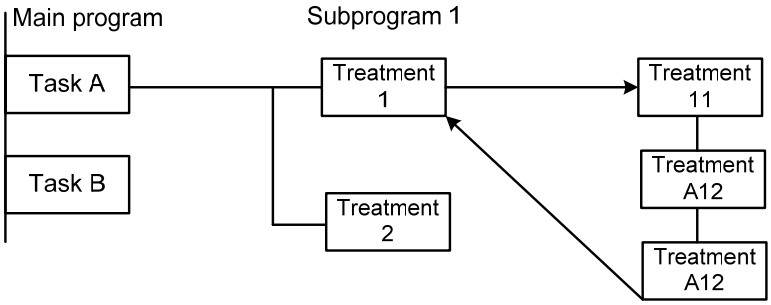


Fig. 2-4-3

2.5 The Treatment of the Input/Output Signal

The treatment of the input signal:

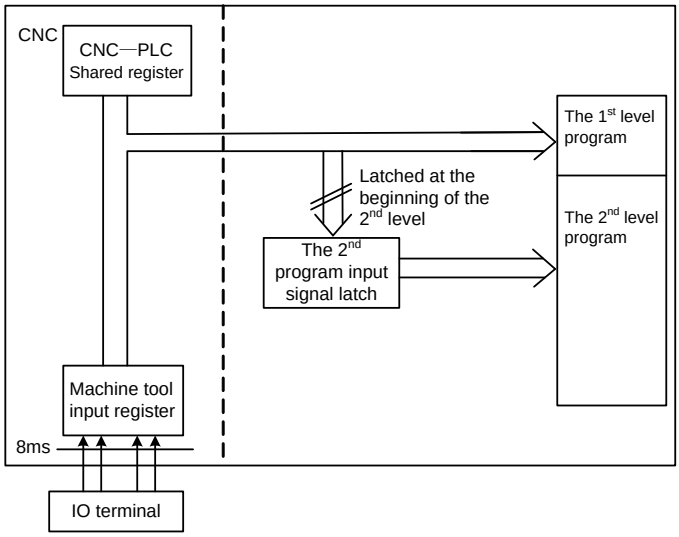


Fig. 2-5-1

The treatment of the output signal:

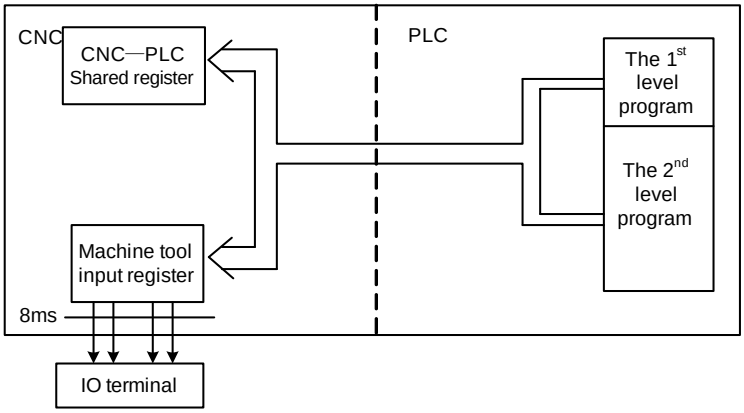


Fig. 2-5-2

2.5.1 Input Signal Treatment

(1) NC input register

The NC input signals from the NC are memorized into the NC input register, which are transferred to PLC each 8ms. The 1st level program performs the corresponding treatment using state of these signals.

(2) Machine tool input register

The machine tool input register is scanned and memorized its input signal from the machine each 8ms. The 1st level program is also performed the corresponding treatment by using this signals directly.

(3) The 2nd level program input register

The 2nd level program input signal register is also called the 2nd level program synchronic input signal register. Wherein, the stored input signal is treated by the 2nd level program. This signal state in the register is synchronic with the 2nd level one.

The signals both in the NC and machine tool input register can be locked to the 2nd level program input latch, as long as the 2nd level program performs. The signal state in this latch keeps invariable during the performance of the 2nd level program.

2.5.2 The Treatment of the Output Signal

(1) NC output register

The output signal transfers to the NC output register from the PLC each 8ms.

(2) Machine tool output register

The signal memorized in the machine tool output register conveys to the machine tool each 8ms.

Note: The signal states, such as the NC input register, NC output register, machine input register and machine

output register, which can be displayed by the self-diagnosis function. The diagnosis number is the address number in the sequence programming.

2.5.3 The Distinguish of the Signal State Between the 1st Level and the 2nd Level Program

As for the same input signal, their states may different between the 1st and 2nd level programming, that is the reason that different registers are used between two levels programming. Namely, the input signal used with the 2nd level program is the one of the 1st level who is locked. And therefore, the signal in the 2nd level program is later than the 1st level one. At the worst case, one 2nd level program performance cycle can be lagged.
It is better to remember this point when programming the ladder diagram.

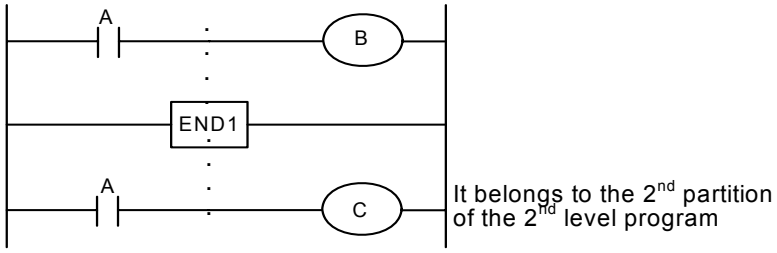


Fig. 2-5-3-1

A=1 performs the 1st level program when the 1st 8ms is performed, then B=1. And therefore, the 2nd level program is performed, the A=1 is latched to the 2nd level program, and then the first partition of the 2nd level program is completed.

A turns into 0 to perform the 1st level program when the 2nd 8ms is performed, then B=0. And therefore, the 2nd partition of the 2nd level program is performed; in this case, the state of the A is still latched as the one last time. So, C=1.

In this way, the state both B and C are different.

2.6 Interlocking

In the sequence control, the interlocking is very important from the safety issue.

It is necessary to use the interlocking in the sequence control programming. Simultaneously, the hard interlocking is used in the relay control circuit of the strong electric cabinet of the machine tool sides. This is the reason that the interlocking is disabled when the hardware of the performance sequence programming malfunctions, even if the interlocking is logically used in the sequence program (software). And therefore, the interlocking can be ensured the safety for the user, and prevent the machine tool from damaging in the strong electric cabinet of the machine sides.

Chapter 3 PLC Adrress

Address distinguishes signal. Different address is separately corresponding to the I/O signal at the side of the machine tool, the I/O signal at the side of the CNC, the internal relay, the counter, the timer, the nonvolatile relay and the data list. Each address is composed of the address number and bit number, and its number is as shown below:

Address number rules:
Address number consists of address type, address number and bit number.

X 000 . 6

Type Address number Bit number

Address type: X, Y, R, F, G, K, A, D, C and T
Address number: Decimal number means one byte.
Bit number: Octonary number system, 0～7 are separately indicated the bytes (0～7 bits) in the front of the address number.
The address type of the GSK990MC PLC is shown below:

Table 3-1

Address	Address explanation	Length
X	MT→PLC(64 bytes)	INT8U
Y	PLC→MT(48 bytes)	INT8U
F	CNC→PLC(64 bytes)	INT8U
G	PLC→CNC(64 bytes)	INT8U
R	Intermediate relay (512 bytes)	INT8U
D	Data register (0～255)	INT16U
DC	The data register of the counter preset value	INT16U
C	Counter (0～127)	INT16U
A	PLC alarm detection	INT8U
T	Timer (0～127)	INT16U
DT	The data register of the timer preset value	INT16U
K	Nonvolatile relay（64 bytes）	INT8U

INT8U data type is 8-bit character type without symbol, INT16U data type is 16-bit integral type without symbol.

3.1 Machine → PLC Address（X）

The X address of the GSK990MC PLC composes of two types:
1. The X address is assorted with the I/O input terminal, XS40, XS41, XS42.
2. The X address is assorted with the input button on the MDI panel of the system.

3.1.1 X Address on the I/O Input

48 addresses are defined as INT8U from X0 to X5, which are distributed on the I/O input terminal, XS40, XS41, XS42.
Users can define the signal significance of the X address of the I/O ports based upon the actual cases, which can be connected the machine tool and compiled the corresponding ladder diagram.

3.1.2 X Address on the MDI Panel

There are 11 bytes from the addresses X20 ~ X30, which are corresponded with the button input on the MDI panel one by one. User can not modify its signal definition. The buttons on the MDI panel should be firstly responded by CNC, and then conveys the X signal to PLC.
The corresponding relationships are shown below:

Table 3-1-2-1

Button input	PLC address	Button input	PLC address
Edit mode	X20.0	Rapid F0	X25.0
A uto mode	X20.1	Rapid F25%	X25.1
MDI mode	X20.2	Rapid F50%	X25.2
Zero return mode	X20.3	Rapid F100%	X25.3
Step mode	X20.4	F0% 0.001	X26.0
Manual mode	X20.5	F25% 0.01	X26.1
MPG mode	X20.6	F50% 0.1	X26.2
DNC mode	X20.7	F100% 1	X26.3
Skip	X21.0	Manual feed axis +1st	X27.0
Single	X21.1	Manual feed axis +2nd	X27.1
Dry run	X21.2	Manual feed axis +3rd	X27.2
Miscellaneous lock	X21.3	Manual feed axis +Nth	X27.3
Machine lock	X21.4	Manual feed axis -1st	X28.0
Optional stop	X21.5	Manual feed axis -2nd	X28.1
Program restart	X21.6	Manual feed axis -3rd	X28.2
Light	X21.7	Manual feed axis -Nth	X28.3
Spindle rotation CCW	X22.0	Spindle orientation	X29.0
Spindle stop	X22.1	Overtravel release	X30.0
Spindle rotation CW	X22.2	Spindle override SOV1	X31.0
Spindle JOG	X22.6	Spindle override SOV2	X31.1
Lubricating	X23.0	Spindle override SOV4	X31.2
Cooling	X23.1	Feedrate override FOV1	X31.3
Chip removal	X23.2	Feedrate override FOV2	X31.4
Emergency stop	X23.5	Feedrate override FOV4	X31.5
Cycle start	X23.6	Feedrate override FOV8	X31.6
Feed hold	X23.7	Feedrate override FOV16	X31.7
Rapid switch	X24.7		

3.2 PLC → Address of the Machine Tool Side（Y）

The Y address of the GSK990MC PLC composes of two types:
1. The Y address is assorted with the I/O input terminal, XS43, XS44, XS45.
2. The Y address is assorted with the input button on the MDI panel of the system.

3.2.1 Address on the I/O Output

48 addresses are defined as INT8U from Y0 to Y5, which are distributed on the I/O output terminal, XS43, XS43, XS45.
Users can define the signal significance of the Y address of the I/O ports based upon the actual cases, which can be connected the machine tool and compiled the corresponding ladder diagram.

3.2.2 Y Address on the MDI Panel

There are 8 bytes from the addresses Y12 ~ Y19 which these addresses are corresponded with the button input on the MDI panel one by one. User can not modify its signal definition. PLC system reports to the CNC system keyboard module after calculating, and it is used for displaying the indicator signal.
The corresponding relationships of each prompt light:

Table 3-2-2-1

Keyboard indicator output	PLC address	Keyboard indicator output	PLC address
Edit key indicator	Y12.0	Chip removal indicator	Y15.0
Auto key indicator	Y12.1	Feedrate override cancel key indicator	Y15.1
MDI key indicator	Y12.2	Rapid switch indicator	Y15.2
Zero return key indicator	Y12.3	0.1/50% indicator	Y15.5
Step key indicator	Y12.4	Spidle orientation indicator	Y15.7
Manual key indicator	Y12.5	Magazine tool clamping tool indicator	Y16.5
MPG key indicator	Y12.6	Magazine tool change indicator	Y16.6
DNC key indicator	Y12.7	USER3 indicator	Y16.7

Keyboard indicator output	PLC address	Keyboard indicator output	PLC address
Spindel rotation(CCW) indicator	Y13.0	+the 1st axis key indicator	Y17.0
Spindel rotation(CW) indicator	Y13.1	+ the 2nd axis key indicator	Y17.1
Spindel stop indicator	Y13.2	+ the 3rd axis key indicator	Y17.2
The 1st axis zero return indicator	Y13.3	+ the 4th axis key indicator	Y17.3
The 2nd axis zero return indicator	Y13.4	- the 1st axis key indicator	Y18.0
The 3rd axis zero return indicator	Y13.5	- the 2nd axis key indicator	Y18.1
Skip indicator	Y14.0	- the 3rd axis key indicator	Y18.2
Single indicator	Y14.1	-the 4th axis key indicator	Y18.3
Drun run indicator	Y14.2	Jog key indicator	Y18.7
Miscellaneous lock indicator	Y14.3	Overtravel release indicator	Y19.0
Machine lock indicator	Y14.4	Feed hold key indicator	Y19.1
Machine light indicator	Y14.5	Cycle start key indicator	Y19.2
Lubricating indicator	Y14.6	Optional stop indicator	Y19.4
Cooling indicator	Y14.7	Program restart indicator	Y19.5

3.3 PLC→CNC Address（G）

The addresses from G0 to G63, its definition type: INT8U, totally 64 bytes.
The operation panel key signal is shown below:

Table 3-3-1

Operation panel key signal	PLC address	Operation panel key signal	PLC address
Edit mode	G20.0	Lubricating	G23.0
Auto mode	G20.1	Cooling	G23.1
MDI mode	G20.2	Chip removal	G23.2
Zero return mode	G20.3	Cycle start	G23.6
Step mode	G20.4	Feed hold	G23.7
Manual mode	G20.5	Feedrate override cancel	G24.1
MPG mode	G20.6	Rapid switch	G24.7
DNC mode	G20.7	MPG/incremental feed movement amount's selection signal 1	G26.4
Skip	G21.0	MPG/incremental feed movement amount's selection signal 12	G26.5
Single	G21.1	Manual feed axis +1st	G27.0
Dry run	G21.2	Manual feed axis +2nd	G27.1
Miscellaneous lock	G21.3	Manual feed axis +3rd	G27.2
Machine lock	G21.4	Manual feed axis +Nth	G27.3
Optional stop	G21.5	Manual feed axis -1st	G28.0
Program restart	G21.6	Manual feed axis -2nd	G28.1
Spindle rotation CCW	G22.0	Manual feed axis -3rd	G28.2
Spindel stop	G22.1	Manual feed axis -Nth	G28.3
Spindle rotation CW	G22.2	Spindle orientation	G29.0
Spindle override cancel	G22.4	Overtravel release	G30.0
Spindle jog	G22.6		

G63 byte's bit signal is used by the system interior. G63.0, G63.1, G63.2 is the separate system interior's response signal when M, S, T execution is completed.

3.4 CNC→PLC Address （F）

The addresses from F0 to F63 are defined as: INT8U, totally 64 bytes.
Refer to the Chapter Three Function for details.

3.5 Internal Replay Address（R）

The address area is reset when the system is turned on. R510 and R511 are used by the system.
Its definition type is: INT8U, totally 512 bytes.

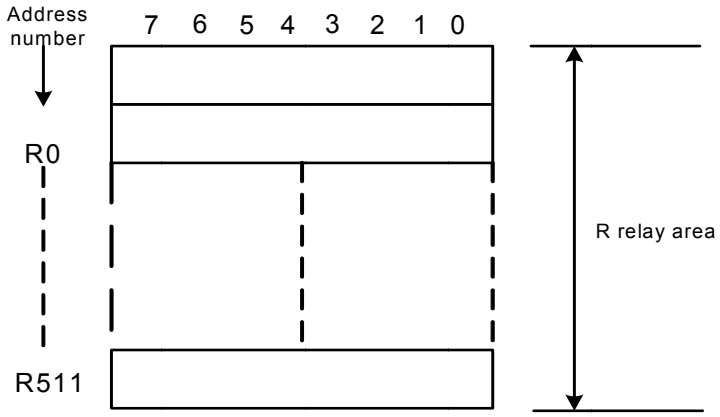


Fig.3-5-1

System program administration area:

R510

The signal of R510.0 address is set to 1 when PLC starts and restarts, which is used the signal set by the initial user. The R510.0 is reset to 0 after the ladder diagram is performed once.

R511（System timer）

The following four signals can be used for system timer:

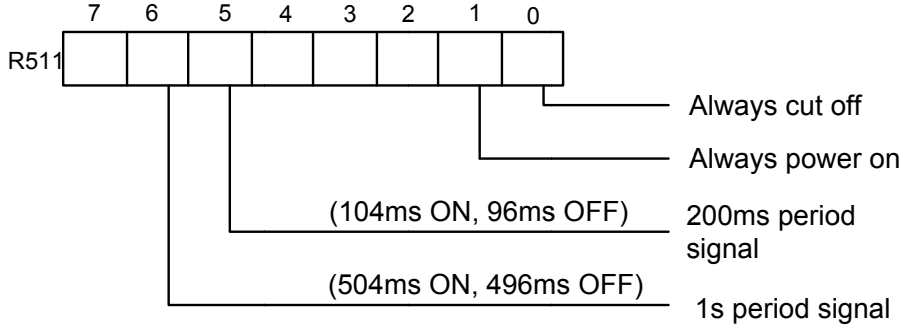


Fig. 3-5-2

3.6 Nonvolatile Relay Address（K）

This address area is used for nonvolatile replay and PLC parameter setting. This area is called nonvolatile relay area, namely, the content inside the register will not lose even if the system is turned off. K000~~K005 are used by the system, which is used to protect the PLC system parameter, it is very convenient for user to control PLC in the CNC system.

Its definition type: INT8U, totally 64 bytes.

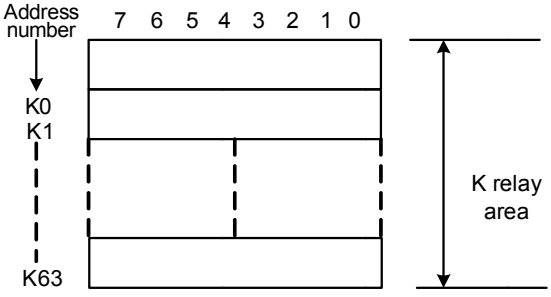


Fig. 3-6-1

Note: When PLC address K005.2 =1, PLC enters the debugging mode. All of the external alarms are cancelled, and the machine interlocking signals are then cancelled, the tool-change code can not be performed. The parameter can be modified only when comprehending the parameter, so that the damage in the machine tool or injury of the person may occur.

3.7 Information Display Request Address（A）

This address area is reset when the system is turned on
Its definition type: INT8U, totally 32 bytes.

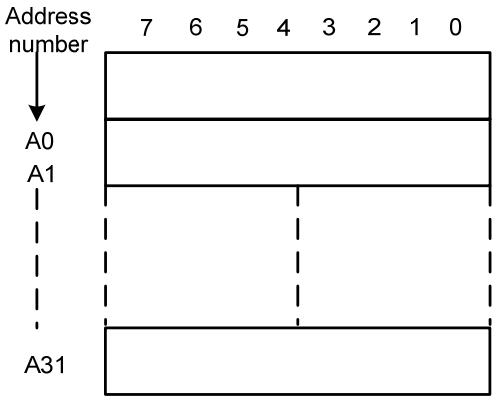


Fig. 3-7-1

3.8 Counter Timer（C）

This area is used for placing the current count value of the counter. The data is reset after the system is turned off.
Its definition type: 128 addresses.

3.9 Counter Preset Value Address（DC）

This address area is used for storing the counter preset, which is a nonvolatile storage area, that is, the memorized content may not loose even the system is power off.
Its definition type: 128 addresses. The setting value of the DC is only read instead of writing.

3.10 Timer Address（T）

This address area is used for storing the current numerical value of the timer. The data initial is presetting value after the system is power off. Current data is presetting value when it is set to 0.
Its definition type: 128 addresses

3.11 Presetting Value Address of the Timer（DT）

This address area is used for placing the timer preset value. This area is nonvolatile register area, namely, the content inside the register will not lose even if the power of the system is turned off.
Its definition type: 128 addresses. The setting value of the DT is only read instead of writing.

3.12 Data Table Address（D）

The content inside the memory will not lose even if the power of the system is turned off.
Its definition type: totally 256 addresses. Among them, D240～247 are used by the system instead of the user.

3.13 Label Address（L）

It is used to specify labels both skip object and the LBL code in the JMPB code.

Its range: 0～99

3.14 Subprogram Number（P）

It is used to specify the called object subprogram number in the CALL code and the subprogram number in the SP code.

Its range: 0～99

Chapter 4 PLC Basic Codes

The design of the sequence program begins from the compiling of the ladder diagram. The ladder diagram consists of relay contact and function code. The logic relationship in the ladder diagram composes of sequence program. There are two methods of the sequence program input: one is that the input method uses the mnemonic symbol language (The system is not temporarily supported the PLC instruction code of the RD, AND and OR); the other one that is used the relay symbol. The programming can be compiled using ladder diagram, and do not comprehend the PLC code based upon the latter.
Actually, the sequence program inside the system can be converted into corresponding PLC code even if it is input by the relay symbol.
The basis codes are commonly used codes when designing the sequence programming, which are performed one-digit calculation.
The basis instruction codes of the GSK990MC are shown below:

Table 4-1

Code name	**Function**
RD	Left shift one bit of the content of the register, the signal state specified by address set to ST0
RD.NOT	Left shift one bit of the content of the register, the signal state specified by address is set to ST0 after its state is set to NOT.
WRT	Output the logic calculation result to the specified address
WRT.NOT	Output the logic calculation result after NOT to the specified address.
AND	Logic AND
AND.NOT	Logic AND after the specified state is set to NOT.
OR	Logic OR
OR.NOT	Logic OR after the specified state is set to NOT.
OR. STK	Right shift one bit of the stacked memory after ST0 and ST1 logic OR
AND.STK	Right shift one bit of the stacked memory after ST0 and ST1 logic AND

4.1 RD, RD.NOT, WRT, WRT.NOT Code

Mnemonic symbol and function
Table 4-1-1

Mnemonic symbol	**Function**
RD	Left shift one bit of the content of the register, the signal state specified by address is set to ST0.
RD.NOT	Left shift one bit of the content of the register, the signal state specified by address is set to ST0 after it is set to NOT.
WRT	Output the logic calculation result to the specified address
WRT.NOT	Output the logic calculation result after NOT to the specified address

Code explanation
WRT and WRT.NOT codes are the coil drive code of the output relay and internal relay, but the input relay can not be used.
The paratactic WRT instruction can be used multiply, but it outputs with multicoil .

Refer to the following programming:

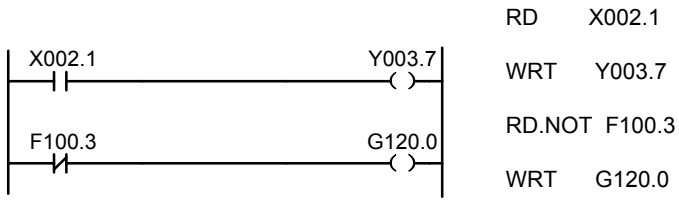


Fig. 4-1-1

4.2 AND, AND.NOT Code

Mnemonic symbol and function

Table 4-2-1

Mnemonic symbol	Function
AND	Logic AND
AND.NOT	Logic AND after the specified state is NOT

Code explanation

Connect 1 contact with series connection by using AND, AND.NOT code. The numbers of series connection contacts are unconstrained, and this code can be used for dozens of times.
Refer to the following programming:

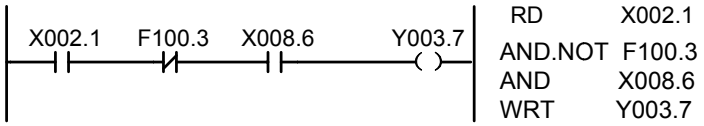


Fig. 4-2-1

4.3 OR, OR.NOT Code

Mnemonic symbol and function

Table 4-3-1

Mnemonic symbol	Function
OR	Logic OR
OR.NOT	Logic OR after the specified state is NOT

Code explanation

Connect 1 contact with series connection using the OR and OR.NOT code.
OR, OR.NOT is started from the step of this code; it can be connected with series connection with the abovementioned RD, RD.NOT code step.
Refer to the following programming:

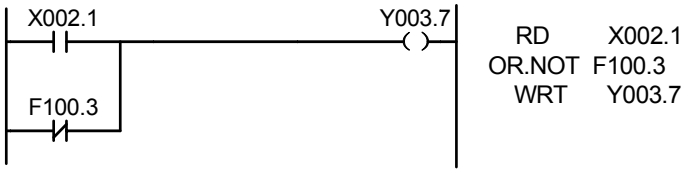


Fig. 4-3-1

4.4 OR. STK Code

Mnemonic symbol and function
Table 4-4-1

Mnemonic symbol	Function
OR. STK	Right shift one bit of the stacked register after ST0 and ST1 logic OR

Code explanation
OR.STK code is the separate code without any address.
Refer to the following programming:

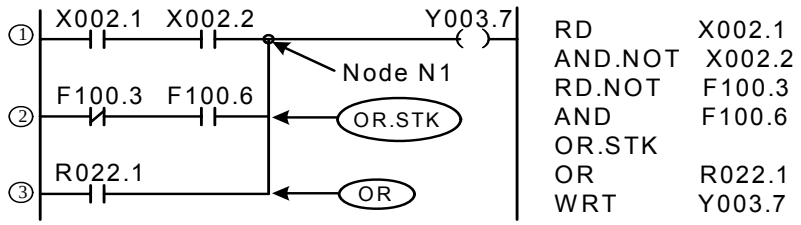


Fig. 4-4-1
There are three branches ①, ② and ③ from the left bus to the node N1. The branches ① and ② are series connection circuit block. When the series connection circuit block is performed between bus to node or among the nodes, other than the first branch, use the RD code when the following branch is ended. The branch ③ is not a series connection circuit block, which can be used by the OR code.

OR. STK and AND. STK are the code without operation component, which indicates the OR , AND relationships between circuit blocks.

4.5 AND.STK Code

Mnemonic symbol and function

Table 4-5-1

Mnemonic symbol	Function
AND.STK	Right shift one bit of the stacked memory after ST0 and ST1 logic AND

Code explanation

Use the AND. STK coded when the branch circuit (parallel circuit block) is connected with series connection with the front of the circuit. The start of the branch is used RD, RD.NOT code. Use the AND. STK code is connected with series connection with the front of the circuit after the series connection circuit block is executed.
AND. STK code is the separate code without any address.

Refer to the following programming:

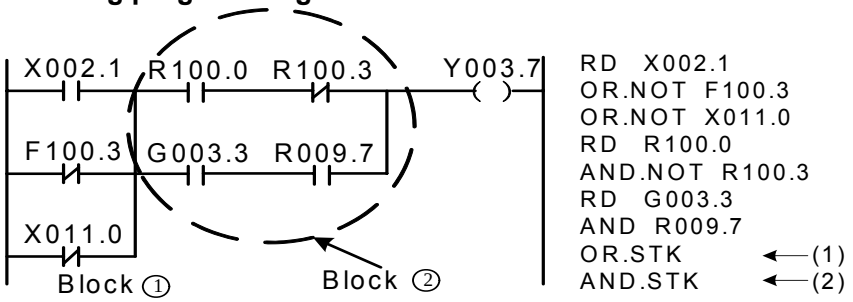


Fig. 4-5-1
As for the abovementioned ladder diagram and instruction table, (1)OR.STK indicates parallel

connection of the series connection circuit block in the block ②, ⑵AND.STK expresses the series connection between circuit block ① and ②.

Chapter 5 PLC Functional Code

Basic codes such as controlling operations of machine tool are difficult to program, therefore, functional instructions are available to facilitate programming.

Table 5-1 (990MC PLC functional instruction code)

No.	Code	Function	No.	Code	Function
1	END1	End of a 1st level ladder program	19	ROT	Binary rotation control
2	END2	End of a 2nd level ladder program	20	SFT	Register shift
3	CALL	Subprogram call	21	DIFU	Rising edge check
4	CALLU	Unconditional subprogram call	22	DIFD	Failing edge check
5	SP	Subprogram	23	COMP	Binary comparison
6	SPE	End of subprogram	24	COIN	Coincidence check
7	SET	Set	25	MOVN	Transfer of an arbitrary number of bytes
8	RST	Reset	26	MOVB	Transfer of 1 byte
9	JMPB	Label jump	27	MOVW	Transfer of 2 bytes
10	LBL	Label	28	XMOV	Indexed data transfer
11	TMR	Timer	29	DSCH	Binary data search
12	TMRB	Fixed timer	30	ADD	Binary addition
13	TMRC	Timer	31	SUB	Binary subtraction
14	CTR	Binary meter	32	ANDF	Functional AND
15	DEC	Binary decoding	33	ORF	Functional OR
16	COD	Binary code conversion	34	NOT	Logical Negation
17	COM	Common line control	35	EOR	Exclusive OR
18	COME	End of common line control			

5.1 END1（1st Level Sequence Program End）

Function**:**
It must be specified once in a sequence program, either at the end of the 1st level sequence, or at the beginning of the 2nd level sequence when there is no 1st level sequence. It can write 500 steps.
Format:

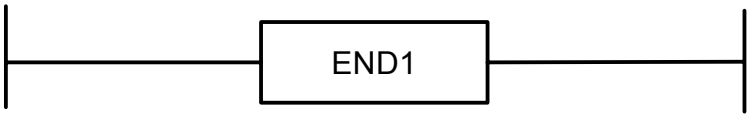


Fig. 5-1-1

5.2 END2（2nd Level Sequence Program End）

Function

Specify at the end of 2nd level sequence.
Format:

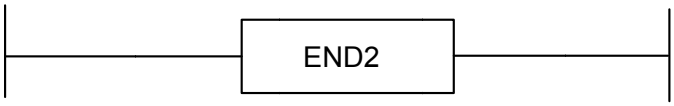


Fig.5-2-1

5.3 CALL（Call Subprogram）

Function

Call a specified subprogram.
CALL has the following additional functions:
The subprogram may be nested up to 18 levels by other subprograms, but if a dead cycle is made by the closed loop calling, an alarm will be issued by system. Therefore to execute the data volume under the control, the allowable subprogram calling times are 100, and the subprogram calling in the 1st level is disabled. Alarm will be issued for the instructions or network between SP and END2, SPE and SP which can't be executed by system.
Format:

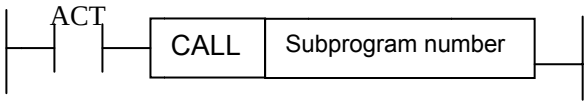


Fig. 5-3-1

Control condition:
ACT＝0，execute the next instruction behind CALL.
ACT＝1，call subprogram which number is specified.
Parameter:
Subprogram number: specifies the subprogram number of a subprogram to be coded following this instruction. Range: 0～99.

5.4 CALLU（Unconditional Subprogram Call）

Function:
Uncodintionally call a specified subprogram.
It has the following characteristics and limits:

The subprogram may be nested up to 18 levels by other subprograms, but if a dead cycle is made by the closed loop calling, an alarm will be issued by system. Therefore to execute the data volume under the control, the allowable subprogram calling times are 100, and the subprogram calling in the 1st level is disabled. Alarm will be issued for the instructions or network between SP and END2, after SPE and before SP which can't be executed by system.
Format:

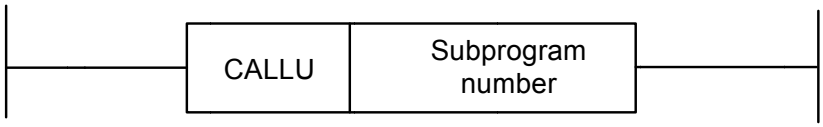


Fig.5-4-1

Parameter:
Subprogram number: specifies the called subprogram number. Range: 0～99.

5.5 SP（Subprogram）

Function:

The SP functional instruction is used to create a subprogram. A subprogram number is specified as a subprogram name. SP is used with the SPE functional instruction to specify the subprogram range.

Note:

1. A subprogram must be written after END2.
2. Another subprogram cannot be nested into a subprogram.

Format:

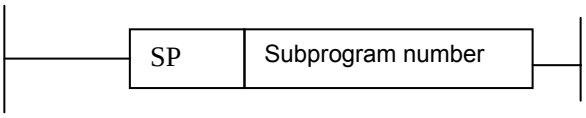


Fig. 5-5-1

Parameter:

Subprogram number: specifies the called subprogram number. Range: 0～99.

5.6 SPE（Subprogram End）

Function:

* it is used to specify the range of subprogram when SPE is used with the S P.
* the control will return to the main program which called the subprogram when the instruction is executed.
* the subprogram is written after END2.

Format:

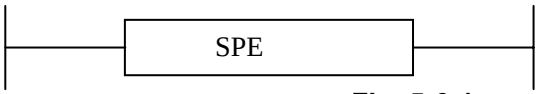


Fig. 5-6-1

Example：

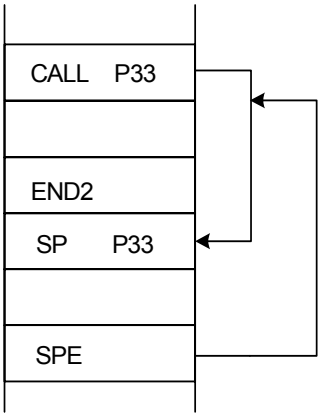


Fig. 5-6-2

5.7 SET（Set）

Function:

Set to 1 for the specified address.

Format:

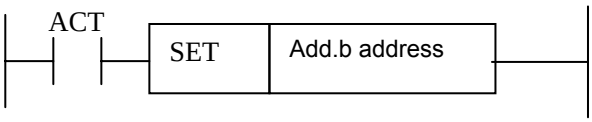


Fig. 5-7-1

Control condition:

ACT＝0，keep add.b invariably.

ACT＝1，set add.b to1.

Parameter:

Add.b：set element address bit can be the output coil, Add= Y，G，R，K，A.

5.8 RST（Reset）

Function:

Set to 0 for the specified address.

Format:

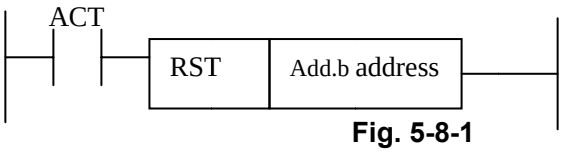


Fig. 5-8-1

Control condition:

ACT＝0，keep add.b invariably.

ACT＝1，set add.b to1.

Parameter:

Add.b：reset element address bit can be the output coil, Add= Y，G，R，K，A.

5.9 JMPB（Label Jump）

Function:

The JUMP functional instruction transfer control to a Ladder immediately after the lable set in a ladder program.

JMPB has the following additional functions:

* More than one jump instruction can be coded for the same label.
* Jumped END1 and END2 are forbidden.
* Jumped subprogram and subprogram are forbidden.
* Jump back is permitted, but the user should handle the infinite loop may be caused by it .
* Jumped main program and subprogram are forbidden.

Format:

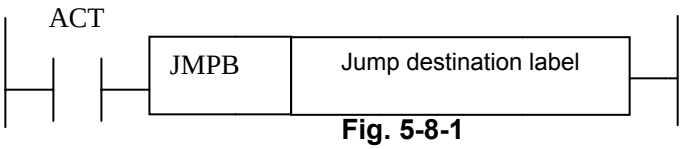


Fig. 5-8-1

Control conditions:

ACT＝0: The next instruction after the JMPB instruction is executed.

ACT＝1: jump to the specified label and executes the next instruction behind the label

Parameter:

Lx: specifies the label of the jump destination. A value from 0 to 99 can be specified.

5.10 LBL（Label）

Function:

The LBL functional instruction specifies a label in a ladder program. It specifies the jump destination for JMPB functional instruction.

Note: one xx label is only specified one time with LBL. Otherwise, the system alarms.

Format:

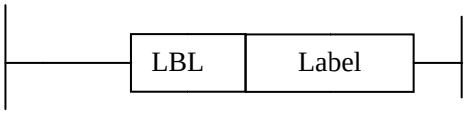


Fig. 5-10-1

Parameter:
xx: specifies the label of the jump destination. Label number range: 0～99.
Example:

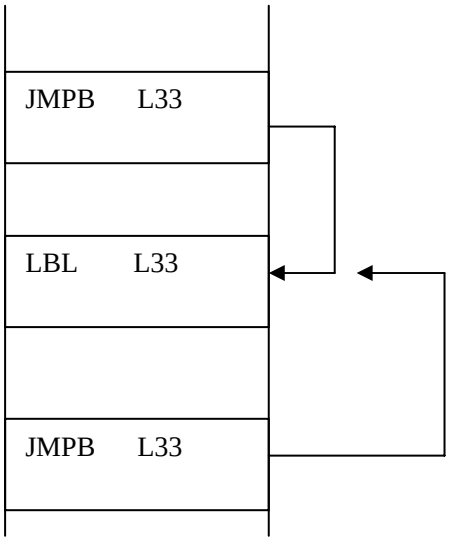


Fig. 5-10-2

5.11 TMR（Timer）

Function:
This is an on-delay timer.
Format:

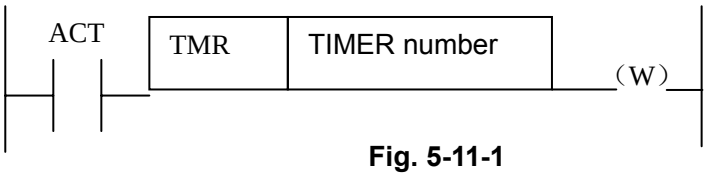


Fig. 5-11-1

Control condition:
ACT=0: turns off the timer relay.
ACT=1: initiates the timer. i.e. timing from 0.
Detailed functions:

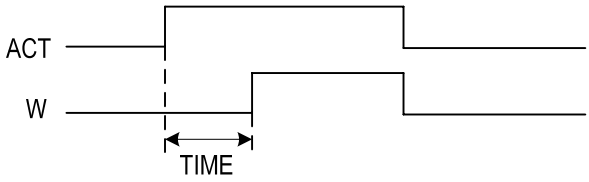


Fig. 5-11-2

Parameter:
TIMER ：timer serial number is named with xxx which are numbers (0～127).
Output:
W ： output coil. W=1 when the output reaches the preset value. W=0 when the output does not reach the preset value.
Note:
Timer is executed each 8ms, take ms as its setting unit, and 8ms is taken as the execution base. Those time less than 8ms are taken as 8ms. i.e. it is set for 54ms, 54=6*8+6, 2ms is needed to be added, so the actual execution time is 56ms.
The time of the timer is set under the 【TMR】of 【PLCPAR】in PRG window.
The system will automatically detect the range of the sequence number of the timer, alarm will be issued for those duplicate or beyond range sequence numbers.

5.12 TMRB（Fixed Timer）

Function:
This is an on-delay timer.
Format:

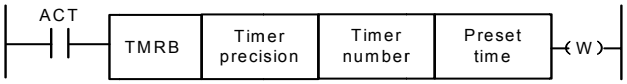


Fig. 5-12-1

Control condition:
ACT=0: turns off the timer relay.
ACT=1: initiates the timer.

Detailed functions:

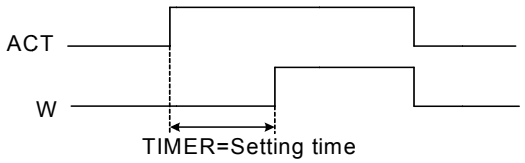


Fig. 5-12-2

Parameter:
TIMER ：timer serial number is named with xxx which are numbers (0～127).

Table 5-12-1（timer accuracy）

Type of timer	Setting number	Setting time	Error
8ms	0	8ms to 524.280s	0 to the 1st level scanning period
48ms	1	48ms to 31.456min	0 to the 1st level scanning period
1s	2	1s to 546 min	0 to the 1st level scanning period
10s	3	10s to 182 h	0 to the 1st level scanning period
1min	4	1min to 65535 min	0 to 1s
1ms	5	1ms to 65.4s	0 to the 1st level scanning period

Preset time：
The fixed time setting of the fixed timer, range: 0~65535.
Output:
W： output coil. W=1 when the output reaches the preset value. W=0 when the output does not reach the preset value.
Note: The system automatically check the timer's sequence number range. An alarm occurs when the serial number is repetitive or exceeds its range. The preset time of the timer is solidified in ROM with the ladder diagram, modifying the ladder diagram.

5.13 TMRC（Timer）

Function:
This is an on-delay timer.

Format:

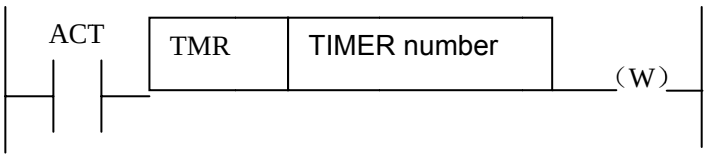


Fig. 5-13-1

Control condition:
ACT=0: turns off the timer relay.
ACT=1: initiates the timer. i.e. timing from 0.

Detailed functions:

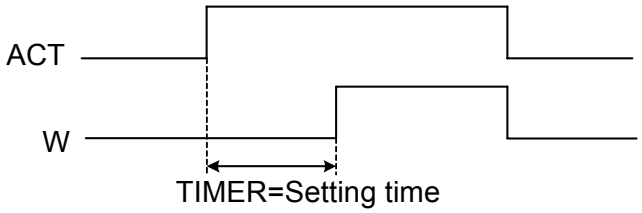


Fig. 5-13-2

Parameter:

TIMER ：timer serial number is named with xxx which are numbers (0～127).

Table 5-12-1（timer accuracy）

Type of timer	Setting number	Setting time	Error
8ms	0	8ms to 524.280s	0 to the 1st level scanning period
48ms	1	48ms to 31.456 min	0 to the 1st level scanning period
1s	2	1s to 546 min	0 to the 1st level scanning period
10s	3	10s to 182 h	0 to the 1st level scanning period
1min	4	1min to 65535min	0 to 1s
1ms	5	1ms to 65.4s	0 to the 1st level scanning period

Output:

W： output coil. W=1 when the output reaches the preset value. W=0 when the output does not reach the preset value.

Note: Time of the timer is set under the 【TMR】of 【+PLCPAR】in PRG window. TMRC timer and TMR timer share one address, so their sequence numbers cannot be repetitive. The system automatically check the timer's sequence number range. An alarm occurs when the serial number is repetitive or exceeds its range.

5.14 CTR（Binary Counter）

Function:

The data in the counter are binary and their functions are as follows:

Preset counter

Preset the count. It outputs a signal when the preset count is reached.

2) Ring counter

Upon reaching the preset count, returns to the initial value by issuing another counter signal.

3) Up/down counter

The count can be either up or down.

Selection of initial value

Its initial value is 0 or 1.

Format:

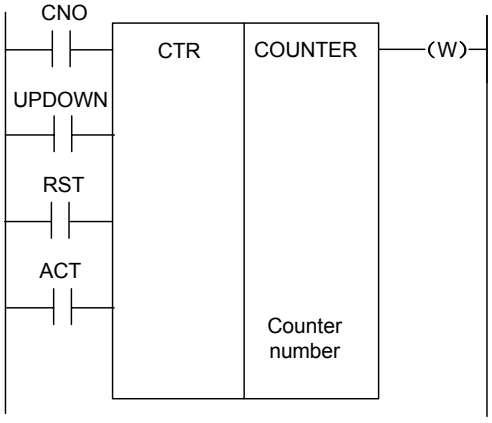


Fig. 5-14-1

Control condition:
Specifies the initial value(CN0):
CN0=0: begins the value of the counter with 0.
CN0=1 begins the value of the counter with 1.
Specify up or down counter (UPDOWN):
UPDOWN=1: Up counter
UPDOWN=0: Down counter
Reset (RST):
RST=0: release reset.
RST=1: enable reset. When W=0, the integrated value is reset to the initial value. RST is set to 1 only when reset is required.
Count signal(ACT):
ACT=1：count is made by catching the rise of ACT.
ACT＝0：counter does not operate. W does not change.
Parameter:
METER：specifies the counter serial number with xxx which are numbers (0～127).

Output:
W：coil output. W=1 when the counter reaches the preset value.
Note 1: The system automatically check the counter's sequence number range. An alarm occurs when the serial number is repetitive or exceeds its range.
Note 2: After the ladder is upgraded, the current value of the counter is cleared.
To get reliable counter counting, reset the counter by the pulse signal before counting.

5.15 DEC（Binary Decode）

Function:
DEC can decode binary code data. Outputs 1 when the eight-digit BCD signal is equal to a specified number, and 0 when not.
It is mainly used to decode M or T function.
Format：

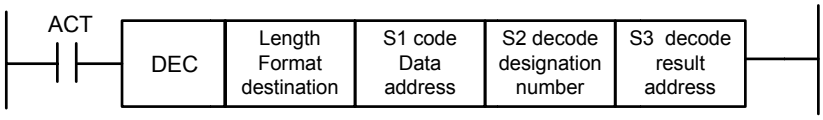


Fig. 5-15-1

Control condition:

ACT＝0： resets all the output data bit.
ACT＝1： decode data. Results of processing is set in the output data address.
Parameter:
length : Set the size of code data to the 1st digit of the parameter.
0001：code data is in binary format of 1 byte length.
0002：code data is in binary format of 2 byte length.
S1 : code data address. Specifies an address at which code data is stored.
S2 : number specification decode designation. Specifies the first of the 8 (1 byte) or 16 (2 bytes) continuous numbers to be decoded.
S3 : decode result address. Specifies an address where the decoded result shall be output. A one-byte or two-byte area is necessary in the memory for the output.
Example：

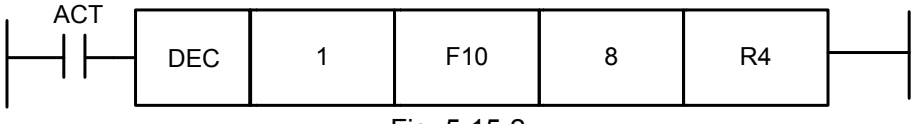


Fig. 5-15-2

When ACT＝1 and F10＝8，R4＝0000,0001；
When ACT＝1 and F10＝9，R4＝0000,0010；

……
When ACT＝1 and F10＝15，R4＝1000,0000；

5.16 COD（Binary Code Conversion）

Function:
COD instruction automatically creates a table with corresponding size used for user inputting conversion table data when it inputs the data capacity. Each table has 10 lattices and if it is not divided by 10, count the lattices by its quotient adding 1, but its capacity data does not change.
Format:

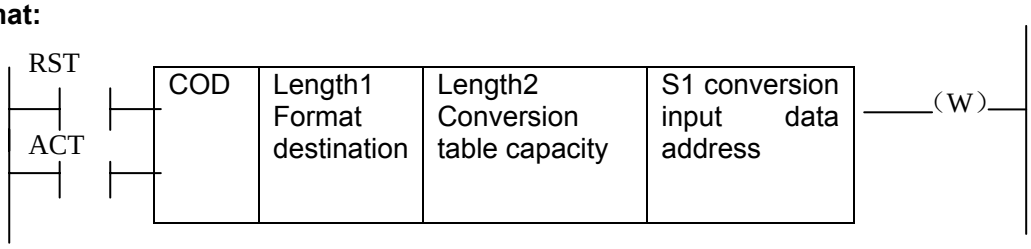


Fig. 5-16-1

Table 5-16-1

S1	0	1	2	……	9
S2	XXX	YYY	AAA	……	……
S1	10	11	12	……	N-1
S2	……	……	……	……	UUU

Control conditions:
Reset (RST):
RST=0: do not reset.
RST=1: reset error output W.
Activate instruction (ACT):
ACT＝0: do not execute COD.
ACT＝1: execute COD. Take value of “Conversion input data address(S1)” as the table number of conversion table, take out a corresponding onversion data which corresponds to the table number from the conversion table, output the output address used for the conversion data (S2).

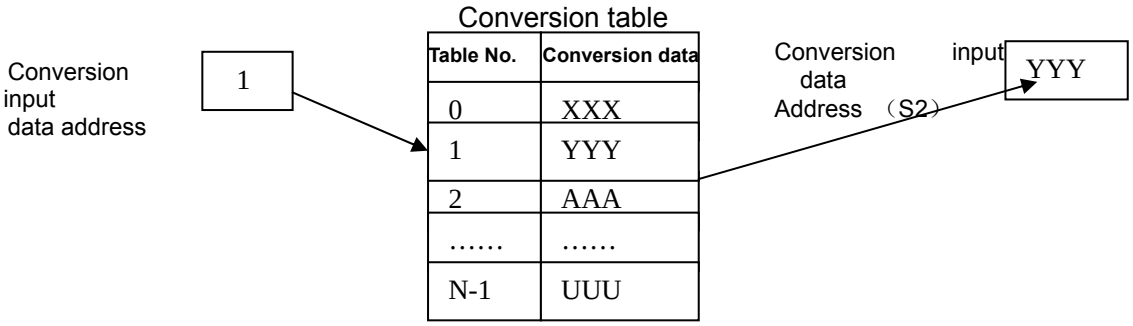


Fig. 5-16-2

Parameter:
Length1 ：designates binary numerical size in the conversion table.
1：Numerical data is binary 1-byte data.
2：Numerical data is binary 2-byte data.
Length2 ：Capacity of conversion table data. 100 data can be made. 100 bytes when designating 1 byte format, and 100 words when 2 byte format. All number is at most 512 bytes in COD conversion table.
S1：Data in the conversion data table can be taken out by specifying the table number. The address specifying the table number is called conversion input data address, and 1-byte memory is required from the specified address.

S2：Conversion data output address. Memory of the byte length specified in the format designation is necessary from the specified address.

Output:

If there are any abnormality when executing the CODB instruction, W=1

Note: Size of the conversion data table is maximum 100. This conversion data table is programmed between the parameter conversion data output address of this instruction and the error output (W).

5.17 COM (Common Line Control)

Function:

This function can be used for specifying the number of coil till the common end code COME. If the common line end instruction is not specified, the system will alarm.

Format：

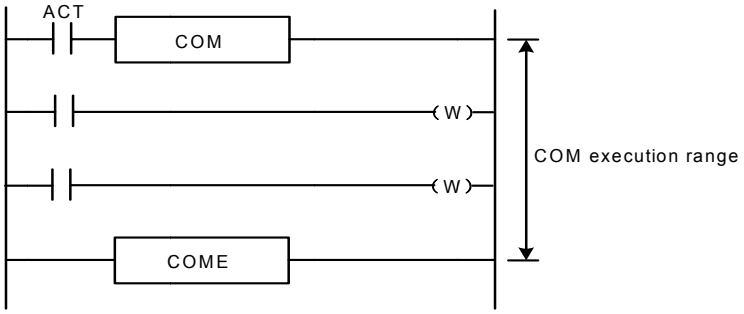


Fig.5-17-1

Control condition:

ACT=0: The specified number of coils or the coils within the region specified are unconditionally turned off (W=0).

ACT=1: it is the same with COM which is not executed.

Note 1：In the range specified with a COM instruction, no additional COM instruction can be specified.

Note 2：The coil for WRT.NOT in the range specified with a COM instruction is singly set to 1 when COM ACT=0.

Note 3：Do not use JMPB,END, END2, CALL, CALLU, LBL,SP,SPE, COM, COM between COM and COME, otherwise, an alarm occurs.

5.18 COME (Common Line Control End)

Function:

The instruction can be used to specify the control range of the common control line instruction (COM). This instruction cannot be used alone. It must be used together with the COM instruction.

Format:

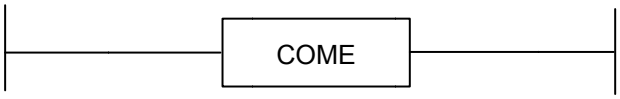


Fig. 5-18-1

5.19 ROT（Binary Rotation Control）

Function:

Controls rotors, such as the tool post, rotary table, etc., and it is used for the following functions.

1. Selection of the rotation direction via the shorter path.
2. Calculation of the number of steps between the current position and the goal position; calculation of the position on position before the goal to the number of steps up to one position before the goal.
3. To calculate the position number just before the target position or the steps to the position just before the target position.

Format:

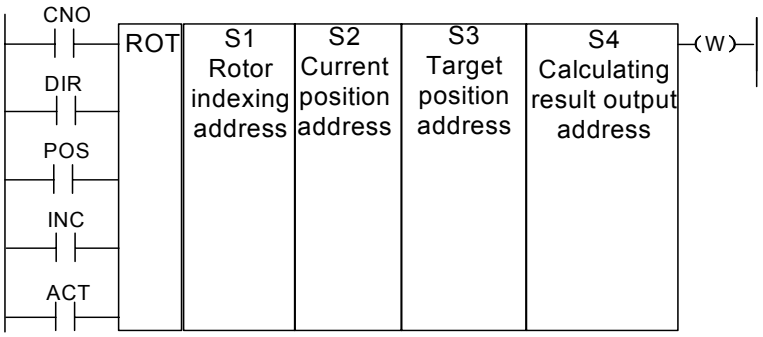


Fig.5-19-1

Control conditions:

Specify the starting number of the rotor(CN0):

CNO=0: begins the number of the position of the rotor with 0.

CNO=1: begins the number of the position of the rotor with 1.

Select the rotation direction via the shorter path or not: (DIR):

DIR=0: no direction is selected. The direction of rotation is only forward.

DIR=1: selected. The direction of rotation is forward/backward.

Specify the operating conditions (POS):

POS=0: calculate the goal position.

POS=1: calculates the position one position before the goal position.

Specify the position or the number of steps(INC):

INC=0: calculates the number of the position. If the position one position before the goal position is to be calculated, specify INC=0 and POS=1.

INC=1: calculates the number of steps. If the difference between the current position and the goal position is to be calculated, specify INC=1 and POS=0.

Execution instruction (ACT):

ACT= 0：the ROT instruction is not executed. W does not change.

ACT＝1：executed. Normally, set ACT=0. If the operation results are required, set ACT=1.

Parameter:

S1 ： specify the rotor indexing number.

S2 ： specify the address storing the current position.

S3 ： specify the address storing the goal position(or instruction value), for example the address storing the CNC output T code.

S4 ： calculate the number of steps for the rotor to rotate, the number of steps up to the position one position before, or the position before the goal. When the calculating result is to be used, always check that if ACT=1.

Output:

W: The direction of rotation for control of rotation via the shorter path is output to W. When W=0, the direction is forward (FOR) when 1, reverse (REV). The definition of FOR and REV is shown in the following figure. If the number given to the rotor is ascending, the rotation is FOR; if descending, REV. The address of W can be determined arbitrarily. When, however, the result of W is to be used, always check that ACT=1.

Example:

Rotor rotation direction:

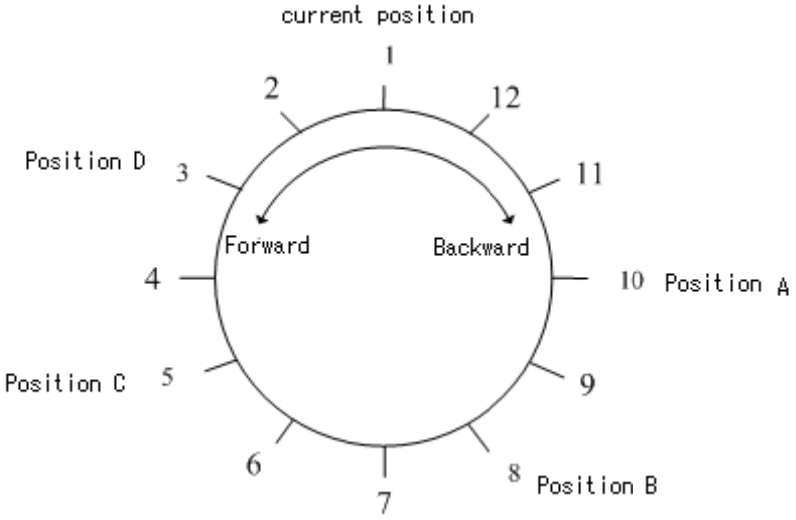


Fig. 5-19-2

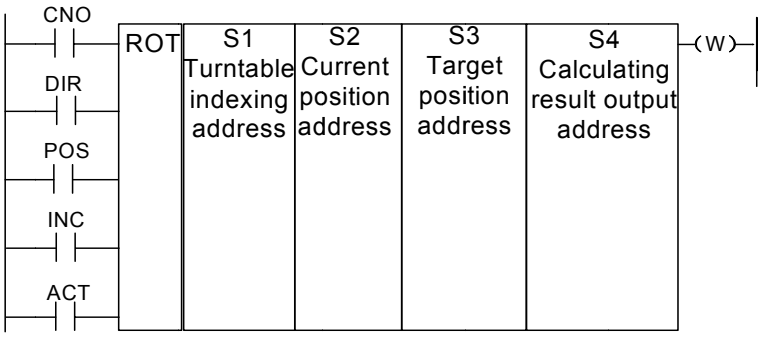


Fig. 5-19-3

Perform the short path rotation, and calculate the position number of previous one position of goal position.

Current position number S2=1, position number of rotation graduation S1＝12，CNO=1，DIR=1 POS=1，INC=0:

When S3=10 goal position is A, and ACT=1, S4＝11，W＝1.

When S3=8 goal position is B, and ACT=1, S4＝9，W＝1.

When S3=5 goal position is C, and ACT=1, S4＝4，W＝0.

When S3=3 goal position is D, and ACT=1, S4＝2，W＝0.

5.20 SFT（Shift Register）

Function:

This instruction can each time shift a byte data (8 bits) by a bits number set by a Parameter, For the circular shifting, each overflowing "1" will be added reversely, i.e. If the highest bit "1" is overflowed by the left shifting, so the lowest bit will be filled by "1", vice versa.

Format：

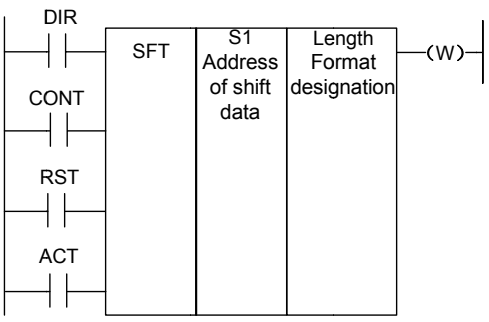


Fig.5-20-1

Control conditions:

Shift direction specification (DIR)

DIR=0: Left shift

DIR=1: Right shift

Condition specification (CONT)

CONT=0: do not cycle shift

CONT=1: cycle shift

Reset（RST）

The shifted out data(W=1) is reset (W=0).

RST=0: W is not reset.

RST=1: W is reset (W=0).

Actuation signal (ACT)

ACT=0: do not execute SFT instruction.

ACT=1:shifting processing is done when ACT=1. For shifting one bit only, execute an instruction when ACT=1, and then, set ACT to 0.

Parameter:

S1 ：set the big shift data address which consists of a storage area with one byte.

Length ：a 4-digit number，its deifinition is shown below:

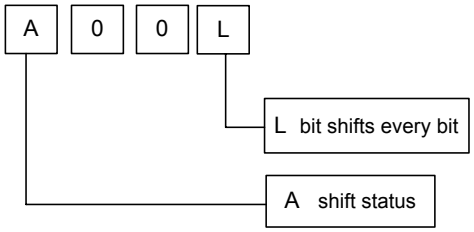


Fig. 5-20-2

L ：range: 0~8.

A ：bit parameter. A=0: When ACT=1 is shifting, the shift period is one bit.

A=1: ACT is taken as a pulse signal, it is 1 from 0, shift one bit.

Output:

W ： W=0: “1” was not shifted out because of the shift operation.

W=1: “1” was shifted out because of the shift operation.

5.21 DIFU（Rising Edge Check）

Function:

The DIFU instruction sets the output signal to 1 for one scanning cycle on a rising edge of the input signal.

Format:

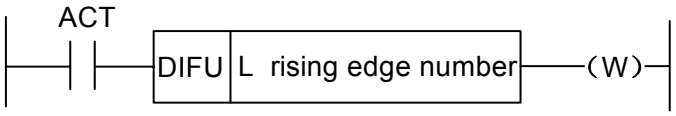


Fig. 5-21-1

Control condition:

Input signal: On a rising edge（0→1）of the input signal, the output signal is set to 1.

Output signal: The output signal level remains at 1 for one scanning cycle of the ladder level where this functional instruction is operating.

Parameter: Rising edge number

Parameter： L : rising edge number, range 0~255. Another DIFU instruction or DIFD instruction in the ladder uses the same number, an alarm occurs.

Operation:

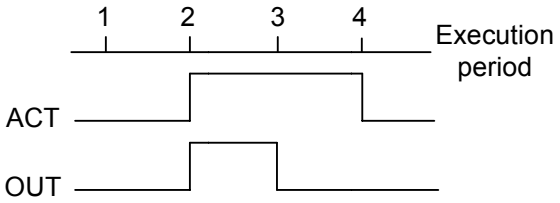


Fig. 5-21-2

The system will check the sequence number of the rising edge automatically, when the number exceeds the range or the number is duplicated, an alarm occurs.

5.22 DIFD（Falling Edge Check）

Function:

The DIFD instruction set the output signal to 1 for one scanning period on a falling edge of the input signal.

Format:

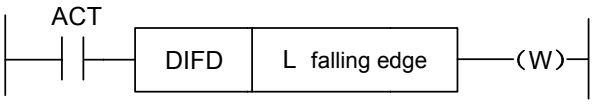


Fig. 5-22-1

Control conditions:

Input signal: on a falling edge（1→0）of the input signal, the output signal is set to 1.

Output signal: the output signal level remains at 1 for one scanning period of the ladder level where this functional instruction is operating.

Parameter:

L ： rising edge number, range 0~255. Another DIFU instruction or DIFD instruction in the ladder uses the same number, the system will alarm.

Operation

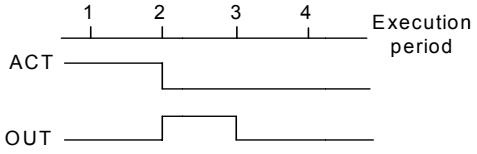


Fig. 5-22-2

The system checks the sequence number of the falling edge automatically, when the number exceeds the range or the number is duplicated, alarm occurs.

5.23 COMP（Binary Comparison）

Function:

Compares binary values. Specifies enough byte to store the input data and the comparison data in the memory.

Format:

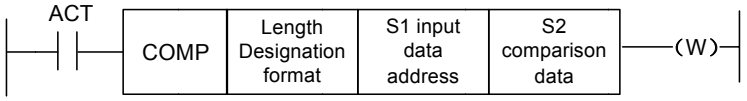


Fig. 5-23-1

Control conditions:

ACT＝0: The COMP instruction is not executed. W does not alter.

ACT＝1: The COMP instruction is executed.

Parameter:

Length：specification format(constant or address) and data length(1 or 2 bytes) for the input data.

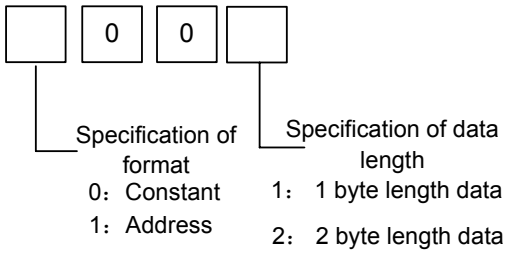


Fig. 5-23-2

S1, S2: content of comparison source 1 and comparison source 2. It can be constant and also be address number.

Address number: R, X, Y, F, G, K, A, D, T, C.

Output:

W=0： input data>comparison data

W=1： input data ≤comparison data

5.24 COIN（Coincidence Check）

Function:

Check whether the input value and comparison value coincide.

Format:

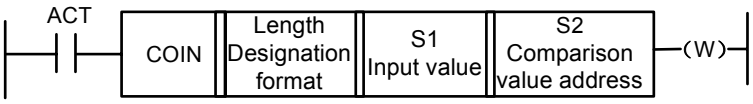


Fig.5-24-1

Control conditions:

ACT＝0，the COIN instruction is not executed. W does not change.

ACT＝1，the COIN instruction is executed.

Parameter:

Length：specification format(constant or address) and data length(1 or 2 bytes) for the input data.

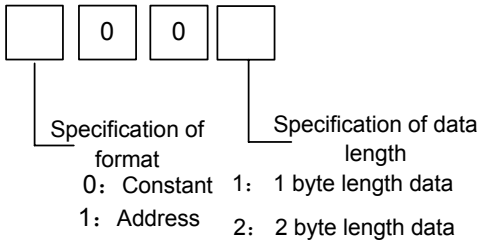


Fig. 5-24-2

S1 ： The input data can be specified as either a constant or an address storing it.

S2 ： address storing of comparison data.

Output:

W ： W=0： input value ≠comparison value

W=1： input value=comparison value

5.25 MOVN（Transfer of Data）

Function:

The MOVN instruction transfers data from source address and a specified binary data to a specified destination address.

Format:

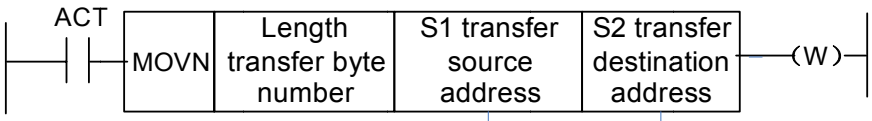


Fig. 5-25-1

Control condition:

ACT＝0: No data is transferred.

ACT＝1: The byte of specified number is transferred.

Parameter:

Length ： transferred byte number.

S1 ： stating byte of address or constant of source data.

Selecting transfer format according to S1:

1. S1 is constant: if S2 is single byte address, S1 in byte unit is copied to address corresponding to Length byte which takes S2 as the initial; if S2 is word unit, S2 in word unit is copied to the address corresponding to Length word which takes S2 as the initial.

2. S1 is address: S1 and S2 transmit the data in byte in spit if S1 and S2 address classifications are matched.

S2 ： starting byte of destination address.

Example:

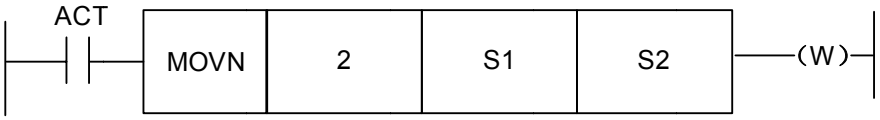


Fig. 5-25-2

1.When S1 is the constant,5 and S2 is R60，R60=00000101,R61=00000101

2.When S1 is the constant ,5 and S2 is D60，D60=5, D61=5.

3.When S1 is the addressD,50 and S2 is D60，D60=50

W=1, the specified number byte is delivered.

W=0, no data be delivered.

If it detects that it exceeds the range of parameter type in transferring , an alarm occurs.

5.26 MOVB（Transfer of One Byte）

Function：

The MOVB instruction transfer one-byte data from a specified source address to a specified destination address.

Format：

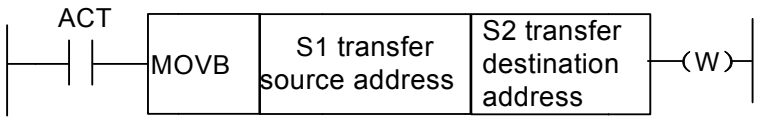


Fig. 5-26-1

Control conditions:

ACT＝0，No data is transferred.

ACT＝1，one-byte data is transferred.

Parameter:

S1 ：source address or constant.

when S2 is a single-byte address, S1 with byte value is copied to S2 address; when S2 is a word address, S1 with byte value is copied to S2 lower-byte address.

S2 ：destination address.

5.27 MOVW（Transfer of Two-Byte）

Function:

The MOVB instruction transfer two-byte data from a specified source address to a specified destination address.

Format:

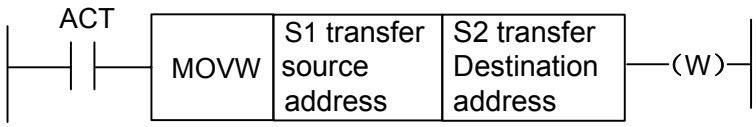


Fig. 5-27-1

Control conditions:

ACT＝0，no data is transferred.

ACT＝1，two-byte is transferred.

Parameter:

S1 ：source address or constant.

S2 ：destination address.

5.28 XMOV（Binary Index Modifier Data Transfer）

Function:

This function instruction instructs reading and rewriting of data in the data table. Number of data (table capacity) in the data table can be specified by specifying the address. In PLC run, perform the data table according to the user' setting.

Format:

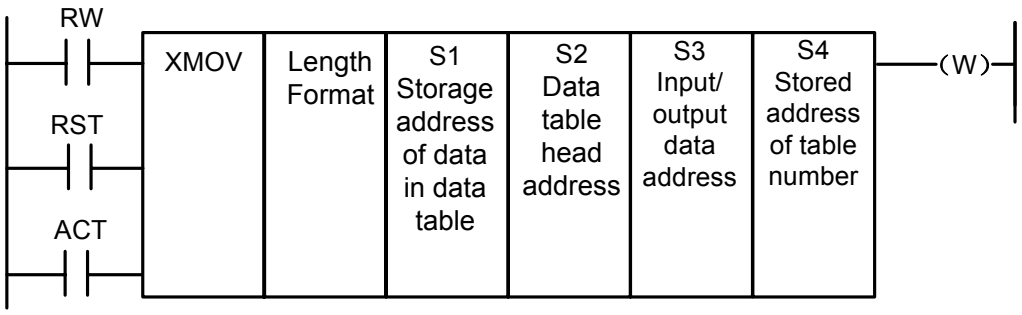


Fig. 5-28-1

Control conditions:

Read, write designation（RW）

RW=0：read data from data table.

RW=1：write data to data table.

Reset（RST）

RST=0： reset release.

RST=1： reset W=0.

Activation code(ACT)

ACT＝0 ：do not execute XMOV，and there is no change in W.

ACT＝1 ：execute XMOV code.

Parameter:

Length ： specifies the transferred data length.

1：1-byte long data.

2：2-byte long data

S1 ： data capacity 's stored address of the data table. The address is used to store the data table's data capacity. Its occupied byte quantity meets the length specified by Length, and the valid range of data is determined by the byte length specified by Length1 format.

1-byte length：1 to 512.

2-byte length：1 to 256. namely 256×2＝512 bytes，which is the PLC data table's capacity.

S2 ： set head address in the data table. The memory area of data table (byte length) X number of data table. The table head address must be the value set in D data table.

S3 ： Input/output data address. In case of reading, set the address of memory which stores a

reading result. In case of the writing, set the address of the memory which stores a writing result, its occupied byte number meets the setting of Length format. Limit the address to D register.

S4 ： Index storage address. It is used to read or write store an index value. Its occupied byte number meets the designation. When the set index address is more than the data stored in S1, error output W=1.

Actual transmission address=head address +index value，index value is 0～(S1-1)，the actual transmission address cannot exceed the data table.

Output:

In the case where the index value exceeds the value set in S1, W=1，the reading or writing of the data table isn't executed.

W=0，no error.

W=1，error found

5.29 DSCH （Binary Data Search）

Function:

The DSCH instruction is used to search the binary data in data table. The number of data (table capacity) in the data table can be specified by specifying the address. Thus allowing change in table capacity even after writing the sequence program in the ROM.

Format:

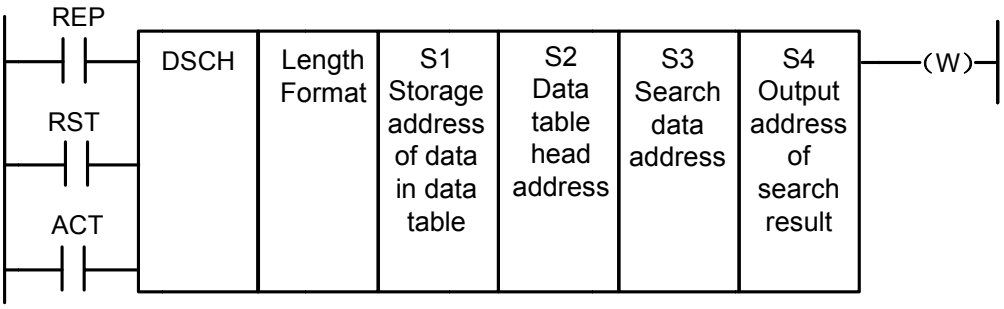


Fig. 5-29-1

Control conditions:

Check repetition（REP）

REP=0：Execute the DSCH instruction, search begins from the head address, and the repetition will be omitted, the search stops when the target data is found in the first time, and output its address. If the searched data is not found, W=1.

REP=1：Execute the DSCH instruction, if the searched data is not found or is two （or more than two）, W=1.

Reset（RST）

RST=0：Release reset.

RST=1：Reset. W=0.

Activation instruction (ACT):

ACT＝0 : Do not execute DSCH instruction, W does not change.

ACT＝1 : Execute DSCH instruction. If the search data is found, table number where the data is stored will be output. If the search data is not found, W becomes 1.

Parameter:

Length ： Specifies data length

1：1-byte long data.

2：2-byte long data.

S1 ：Storage address of number of data in data table. This address requires memory of number of byte according to the format designation. Number of data in the table is n+1(head number in the table is 0 and the last number is n).

S2 ： Data table head address.

S3 ： Search data input address.

S4 ： Search result output address. Actual transmission address=head address +index value，index value is 0～(S1-1)，the actual transmission address cannot exceed the data table. After searching, if search data is found, the table number where the data is stored will be output. The searched table number is output in this search result output address. This address requires memory of number of byte according to the format designation.

Output:

W=0，Search data found.

W=1，Search data not found.

5.30 ADD（Binary Addition）

Function:

This instruction performs binary addition between 1-, 2-byte data. In the operation result register, operation data is set besides the numerical data representing the operation results. The required number of bytes is necessary to store each augend, the added, and the operation output data.

Format:

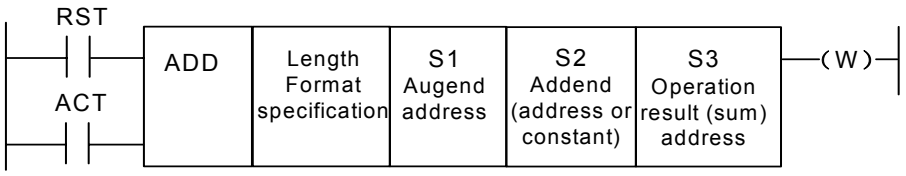


Fig. 5-30-1

Control conditions:

Reset (RST):

RST=0： Release reset.

RST=1： Reset. W=0.

Activation instruction (ACT)：

ACT＝0 ： Do not execute ADD. W does not changed.

ACT＝1 ： Execute ADD.

Parameter:

Length ： Specifies data length(1 or 2 bytes) and the format for the addend(constant or address).

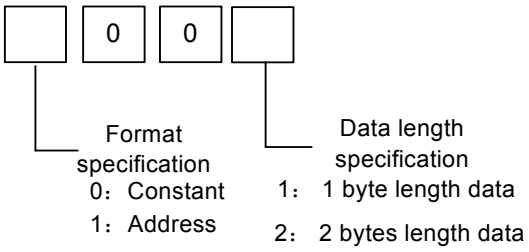


Fig. 5-30-2

S1 ： Address containing the augend

S2 ： Length specification determines the format of the addend.

S3 ： Specify the address to contain the result of output operation.

Output:

W=0： Operation correct.

W=1： Operation incorrect.

When W=1, the result of addition exceeds the specified data length.

5.31 SUB（Binary Subtraction）

Function:

This instruction executes the subtraction operation in the binary format of 1 or 2 bytes. In the operation result register, operation data is set besides the numerical data representing the operation. A required number of bytes is necessary to store the subtrahend, and the result.

Format:

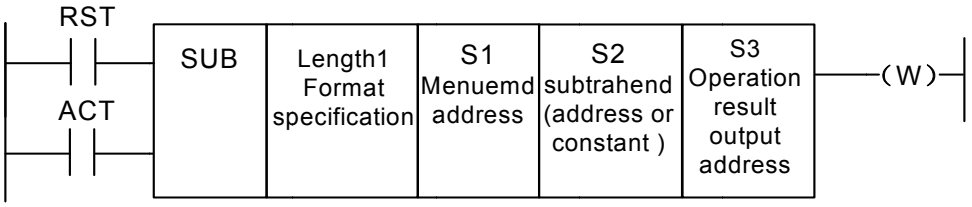


Fig. 5-31-1

Control conditions:

Reset (RST)：

RST=0： Release reset.

RST=1： Reset. W=0.

Activation instruction (ACT)：

ACT＝0 ： Do not execute SUB. W does not change.

ACT＝1 ： Execute SUB.

Parameter:

Length ：Specifies data length(1 or 2 bytes) and the format for the subtrahend(constant or address).

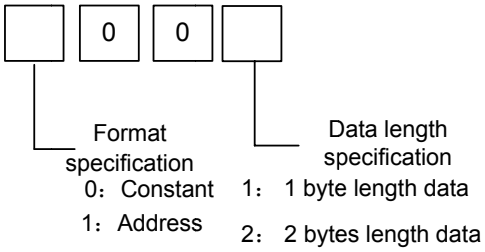


Fig. 5-31-2

S1 ： Address containing the minuend.

S2 ： Specification determines the Length.

S3 ： Specifies the address to contain the result of operation.

Output:

W=0： Operation correct.

W=1： Operation incorrect.

When W=1, the result of subtraction exceeds the specified data length.

5.32 ANDF（Functional And）

Function:

The ANDF instruction ANDFs the contents of address A with a constant (or the contents of address B), and stores the result at address C.

Format:

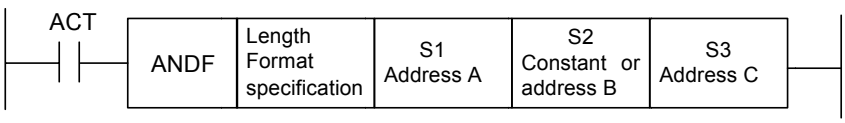


Fig. 5-32-1

Control conditions:

ACT＝0 ： The ANDF instruction is not executed.

ACT＝1 ： The ANDF instruction is executed.

Parameter:

Length ：Specify a data length (1 or 2 bytes), and an input data format (constant or address specification).

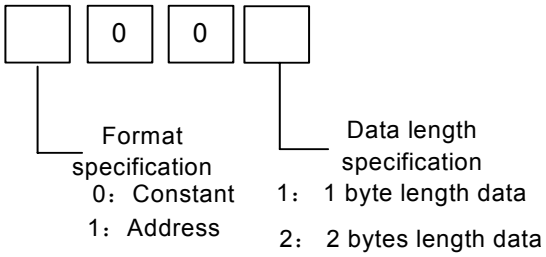


Fig. 5-32-2

S1 ：Input data to be ANDed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 ：Input data to be ANDed with. When address specification is selected in format specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S3 ：Address used to store the result of an ANDF operation. The result of and ANDF operation is stored starting at this address, and has the data length specified in Length format specification.

Example:：

When address A and address B hold the following data:

Address A	1	1	1	0	0	0	1	1
Address B	0	1	0	1	0	1	0	1

The result of the ANDF operation is as follows:

Address C	0	1	0	0	0	0	0	1

5.33 ORF（Functional Or）

Function:：

The ORF instruction ORFs the contents of address A with a constant (or the contents of address B), and stores the result at address C.

Format:

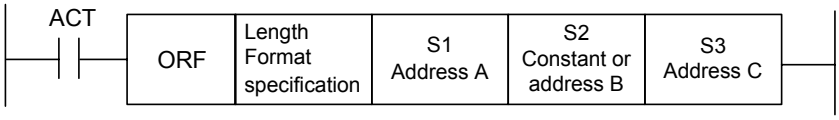


Fig. 5-33-1

Control conditions:

ACT＝0 ： The ORF instruction is not executed.

ACT＝1 ： The ORF instruction is executed.

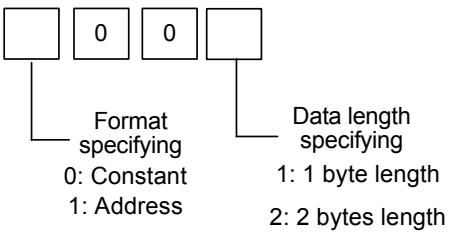


Fig. 5-33-2

Parameter:
Length: Specify a data length(1 or 2 bytes), and an input data format(constant or address specification).

S1 : Specify the input data t o ORed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 : Input data to be ORed with. When address specification is selected in format specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S3 : Address used to store the result of an ORF operation. The result of an ORF operation is stored starting at this address, and has the data length specified in format specification.

Example:

When address A and address B hold the following data:

Address A	1	1	1	0	0	0	1	1
Address B	0	1	0	1	0	1	0	1

ORF operates results are as follows:

Address C	1	1	1	1	0	1	1	1

5.34 NOT（Logical Not）

Function:
The NOT instruction inverts each bit of the contents of address A, and stores the result at address B.

Format:

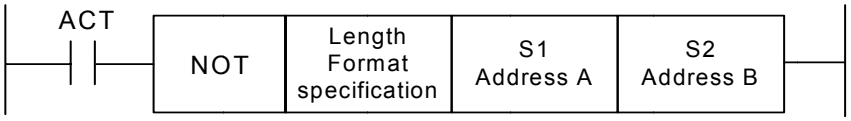


Fig. 5-34-1

Control condition:
ACT＝0: The NOT instruction is not executed.
ACT＝1: The NOT instruction is executed.

Parameter:

Length ：Specifies a data length (1 or 2 bytes).

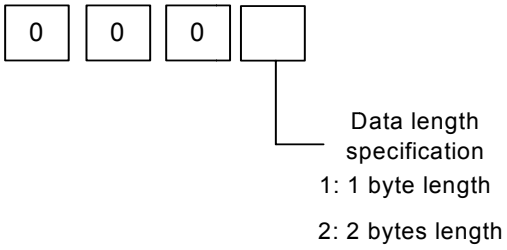


Fig. 5-34-2

S1 ：Input data to be inverted bit by bit. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.

S2 ：Address used to output the result of a NOT operation. The result of a NOT operation is stored starting at this address. And has the data length specified in Length format specification.

Example:

When address A holds the following data:

Address A	1	1	1	0	0	0	1	1

The result of the NOT operation is as follows:

Address B	0	0	0	1	1	1	0	0

5.35 EOR（Exclusive or）

Function:
The EOR instruction exclusive-Ors the contents of address A with a constant (or the contents of address B), and stores the result at address C.
Format:

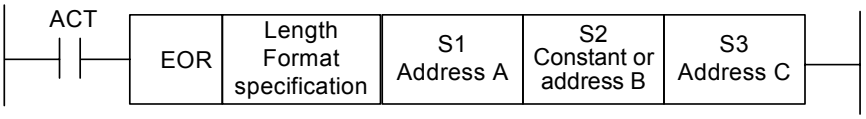


Fig. 5-35-1

Control conditions:
ACT＝0 ： The EOR instruction is not executed.
ACT＝1 ： The EOR instruction is executed.
Parameter:
Length ：Specify a data length (1 or 2 bytes) and an input data format(constant or address specification).

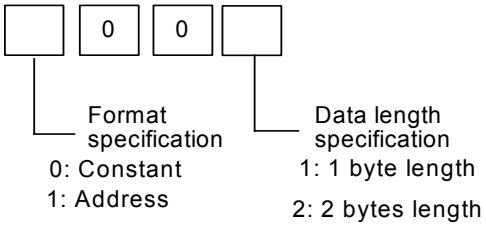


Fig. 5-35-2

S1： Input data to be exclusive-ORed. The data that is held starting at this address and has the data length specified in Length format specification is treated as input data.
S2： Input data to be exclusive-ORed with. When address specification is selected report that specification, the data that is held starting at this address and has the data length specified in Length format specification is treated as input data.
S3： Address used to store the result of an exclusive EOR operation. The result of an exclusive EOR operation is stored starting at this address, and has the data length specified in Length format specification.
Example:
When address A and B hold the following data:

Address A	1	1	1	0	0	0	1	1
Address B	0	1	0	1	0	1	0	1

The result of the exclusive EOR operation is as follows:

Address C	1	0	1	1	0	1	1	0

Chapter 6 Ladder Writing Limit

1. Sequence program must have END1 and END2 which are taken as the end marks of 1st level and 2nd level sequence part, and END1 must be before END2.
2. They only support the parallel output and do not support the multi-level output.
3. The result output address in all basic instructions and output function instruction are not set the following addresses:
   1）Counter preset address DC, timer preset address DT.
   2）K0~K5 address are occupied by the system, and the user can't define them.
   3）G63, R510, R511 address are occupied by the system. and the user can't define them.
   4）X, F address on IO input window.
4. Such case like vertical line overhanging, node disconnected, horizontal through line paralleling to the node network will result in the nodes or network that can' t be executed, so alarm will be issued by the system.
5. Star network, in which there is no direct connection between the vertical lines of different lines in a column, and a line in the middle isn't jointed with a vertical line. So alarm will be issued because the case can't be processed by the system.
6. The upward convex is not allowed in the network. That is there is a parallel network above he nodes of a line, and no line can be connected to this network. So alarm will be issued

The followings are the phrasing error, and an alarm occurs.

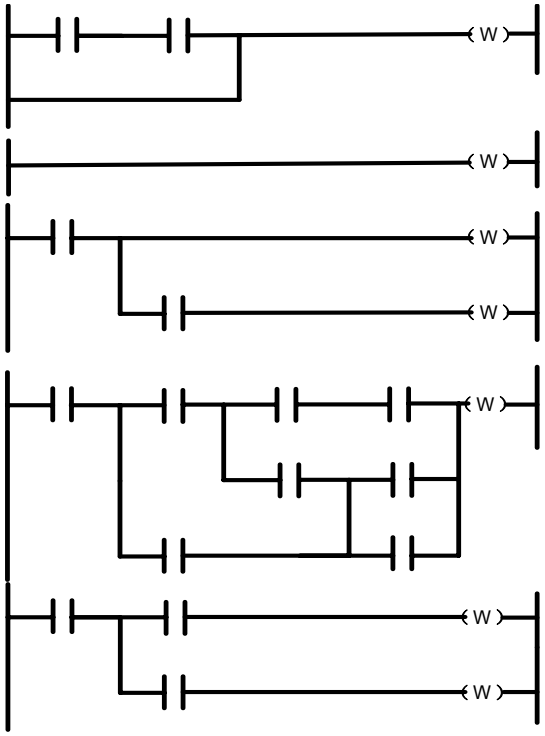


Fig. 6-1

Ⅱ Operation

Chapter 1 PLC Window Display

1.1 Automatic Operation when GSK990MC PLC Power on

PLC starts after power on: it will make use of R510.0 to conduct the net contain it during the first period, and then set R510.0 to “0” which can't be output, the value of the keep relay gets from the PLC last output before stop running.

Note: The keys during < > are the panel; the ones in【 】are the soft keys; 【 】 is the window corresponding the current soft key; ⊞ reports there is the sub-menu in the menu; all operations in PCL are executed during MDI mode and only view and search can be executed during other modes.

1.2 INFO Window Display

1.2.1 INFO Window

1.Press <INFO> key on the panel to enter the default INFOR window as Fig. 1-2-1-1. If the【**INFO**】soft key has not found on the below of the screen, the bit parameter No: N0：26#6=1 can be defined to set the key on the PLC window, and then <**INFO**> is pressed to enter INFO window. There is the version number, modification data, PLC I/O window definition state and so on INFO window.

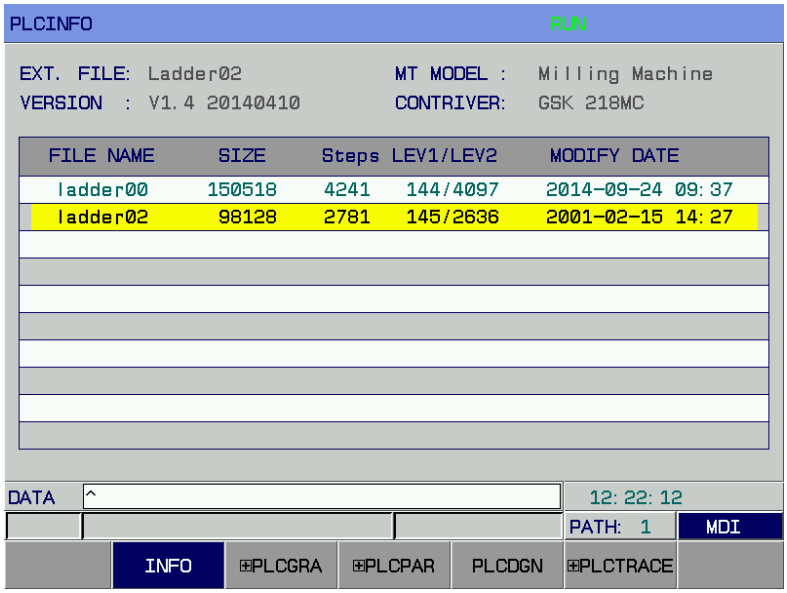


Fig. 1-2-1-1

（1） The system appears the ladder name which is running in the window. The ladder is divided into three: the ladder is the only one that is running, other 15 ladders in No.0-15 ladder besides the one is running, which can be editable or referred.(they can be named with 2-digit serial number except for 0-15).

（2） When the system is turned on, the bit parameter 53#0~#3 setting value is the binary combination parameter, when the setting value is 0, No.0 ladder is used; when it is1~15, No. 1~15 parameter is used. After the system determines to load some ladder which is running (the operation maybe appear the danger, it is enabled after the system restarts). If the format is incorrect, the ladder is deleted to recreated, and the user needs to specify the running ladder No. carefully. Names of all ladder files must be with “ladderXX.grp” (XX is the serial number) , otherwise, the system does not identify the files. The file format is determined by the system, and the user cannot modify the file outside of the system, otherwise, the file maybe be deleted or cannot be identified.

（3） When No. 0~15 ladder is used, M6 separately calls O91000~O91015 macro program.

（4） Selecting ladder. Move the cursor or input “LX”/“LXX”（X/XX is number）to specify the file

name, the system checks whether “X”/“XX” is the known file number after “Enter” is pressed, if the system has not checked it, it creates an ladder with the name “ladder0X.grp” or “ladderXX.grp” . The system automatically creates “END1” and “END2” when the file is created, which can make the user continuously operate the ladder file (it cannot be switched after the file is opened, and the instruction list is always empty). The user can past or cut the ladder diagram (its line number cannot exceed 100 lines, otherwise, the first 100 lines can be performed) which file can be opened. To get safety, after one ladder is opened to executed edit and when it is saved and another file is opened, the system automatically saves the current file. Before the system saves the file, it executes the ladder’ syntax check. When the system finds the syntax errors, it does not save the ladder diagram.

（5） The file head includes the basic information of file, such as row number, step number. The step information is the new one when it is converted. The user can delete the ladder which is not opened and is not running, which must be executed orderly. After the user opens the ladder which is not running, the system stops refreshing the ladder network information to avoid the mistake. The running ladder can execute only the two operations including save and copy, in order that when the user copies the file to other ladder files, and edits the currently running ladder, the user firstly interrupts its running state. When the cursor stops in the background edit file the user can press “**Change**” key to open **Info** to modify the file ground (including ladder version number, adaptive machine tool, ladder maintainance personnel).

1.2.2 PLCGRA Window

Press 【**PLCGRA**】to enter **PLCGRA** window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter **PLCGRA** window as Fig.1-2-2-1：

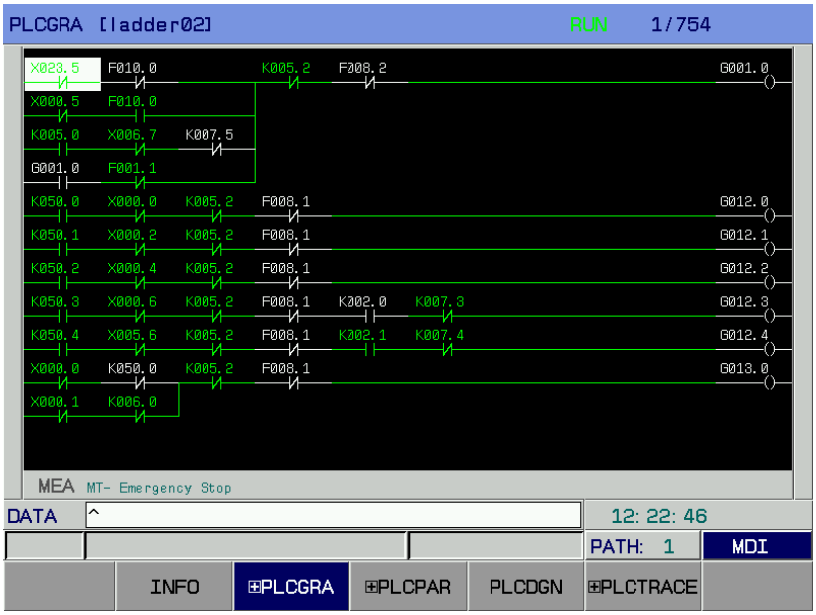


Fig. 1-2-2-1

Contents and operations on **PLCGRA** window:

PLCGRA[ladder01]： current ladder name.

1/821： current line position specified by the cursor during the ladder the cursor.

RUN: operation state of ladder, including RUN/run, STOP/stop, DEBUG/debug.

Diagram: ladder program.

Input：display the input data. Press in the panel to view the input data.

MEA：Commentaries of element positioned by the cursor.

MDI mode: current operation mode

Press the Page Up/Page Down, four Direction keys to search, view and modify the elements.

1.2.3 PLCPAR Window

Press 【⊞PLCGRA】to enter **PLCPAR** window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter **PLCPAR** window as Fig.1-2-3-1:

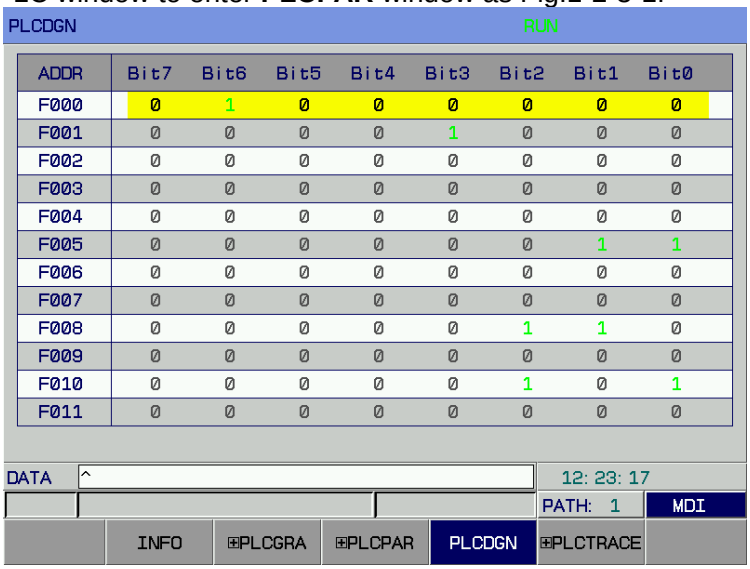


Fig. 1-2-3-1

Contents and operations on PLCPAR window:

RUN ： operation state of ladder

ADDR： keep relay address

Bit0~Bit7 ： bit status of keep relay address

1：the address maintains the state before power OFF

0：the address resets to default state after power OFF

Input: display the input data.

MDI mode: current operation mode(note: the relative parameter of PLCPAR can be modified only in MDI mode).

Press the Page Up/Page Down, four Direction keys to search, view and modify the elements.

1.2.4 PLCDGN Window

Press【**PLCDGN**】to enter PLCDGN window or define the bit parameter N0：26#6=1 to press <**INFO**> key on the PLC window to enter PLCDGN window as Fig.1-2-4-1:

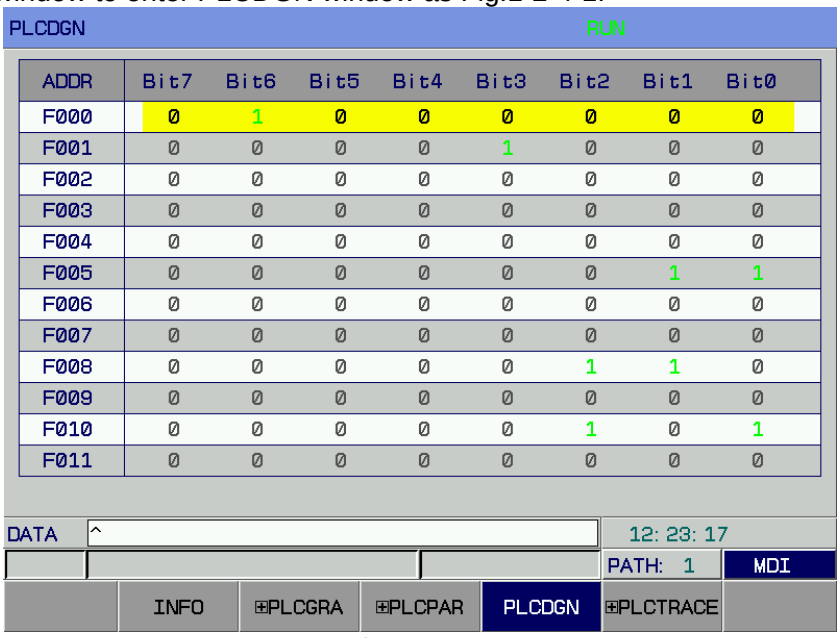


Fig. 1-2-4-1

Contents and operations on PLCDGN window:
RUN：opration state of ladder.
ADDR：address of diagnosis number.
Bit0~Bit7：bit number state of diagnosis address.
1：the signal is connected；0：the signal is not connected.
Input: display the input data.
MDI mode: current operation mode.
Press the Page Up/Page Down, four Direction keys to search the corresponding diagnosis number.
Generally, only the searching can be operated in the window, the I/O window of PLC enters the signal debug mode only when the user gets the authority to set K0.1 to 1. At the moment, the user can modify the X, Y signal.

1.2.5 PLCTRACE Window

PLCTRA window is consist of two windows “Setting” and “TRACE” . Press 【⊞PLCTRA】to enter PLCTRA “SETTING” window.
PLCTRA “SETTING” window is shown in Fig.1-2-5-1:

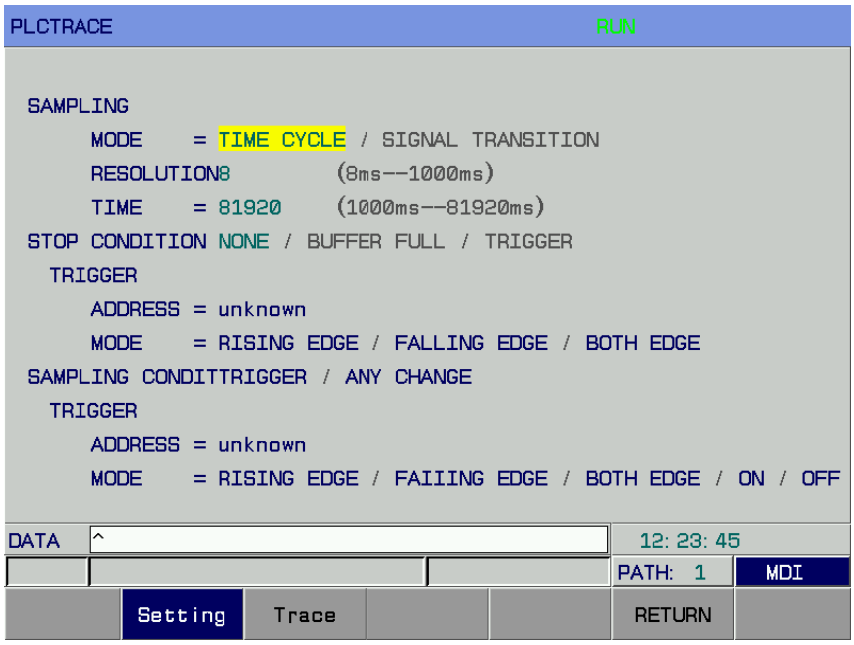


Fig. 1-2-5-1

The content and operation of the **PLCTRA** “SETTING” window
(1) Mode:
- - Periodic cycle: periodic sampling for each time.
- - Signal change: sampling for the change of current signal.

(2) Resolution:
Input the sampling resolution, the default value is the least resolution (8ms), its range is (8ms --1000ms).
The input value uses the multiple of the 8ms.
(3) Time limit:
When the sampling mode is set to “periodic cycle”, then display this parameter. Input the performance time of the trace. The numerical range of the “periodic cycle” is determined by the value of the “resolution” or the specified signal address quantity, and its range is displayed at the right side.

(4) Frame limit:
When the sample mode is set to “signal change”, then display this parameter. Input the sampling quantity, and its range is displayed at the right side.

(5) Stop condition:

- - without: Do not stop tracing.
- - Buffer area full: It stops tracing when the buffer area is full.
- - Signal trigger: It stops tracing by the signal trigger.
Trigger setting: This parameter is enabled when the “stop condition” is selected to the “signal trigger”.
1. Address: The input signal address is regarded as trigger stopping. (R address can not be used for trigger stopping)
2. Mode; It determines that what kind trigger mode is used to stop tracing.
Rising edge: The tracing is automatically stopped by the rising edge of the trigger signal.
Falling edge: The tracing is automatically stopped by the falling edge of the trigger signal.
Any change: The tracing is automatically stopped by the rising or falling edge of the trigger signal.
(6) Sampling condition: This parameter is enabled when the sampling mode is set to “signal change”, which is determined the sampling condition.
- - Signal trigger: The specified mode changes when the signal specified by the trigger address which is set by the sampling condition, collect the signal.
- - Any change: Any change occurs when the signal specified by the trigger address which is set by the sampling condition.
Trigger setting: When the sampling mode is set to “signal change”, and then the sampling condition is set to “signal trigger”, this parameter is enabled.
1. Address: The input signal address, instead of using the R address, is treated as the sampling of the trigger signal.
2. Mode: The trigger mode inputs the specified trigger signal.
Rising edge: The rising edge sampling of the trigger signal specifies the signal state.
Falling edge: The falling edge sampling of the trigger signal specifies the signal state.
Any change: Specify the signal state by the rising or falling edge sampling of the trigger signal.
Switch on: Sample the specified signal state when the trigger signal is switched on.
Switch off: Sample the specified signal state when the trigger signal is switched off.
Enter the PLCTRACE “trace” window by pressing the [trace] soft key. Refer to the 1-2-5-2:

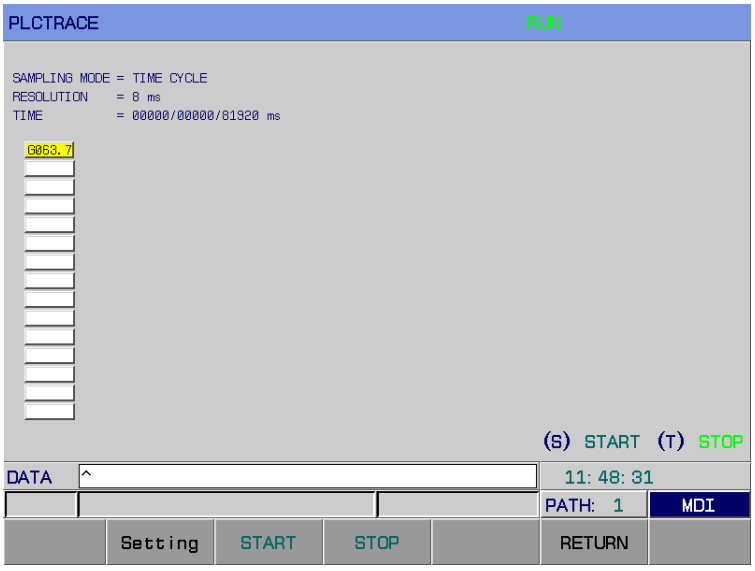
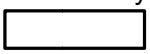


Fig.1-2-5-2

The content and operation of the **PLCTRACE** “trace” window
(1) Sampling mode: Display the current sampling mode of the system.
(2) Period: Display the current sampling period of the system, that is, resolution
(3) Time: This parameter displays when the “sampling mode” selects the “periodic cycle”.
- - Format display when tracing: the current timing is at the left side, and the max. allowance timing is at the right side.
- - Format display when stopping: the most right side timing is placed at the right side; the timing of trace stopping is placed at the middle side, and the max. allowance timing is placed at the right side.

(4) Setting address: Move the cursor by the and , the signal address that will be traced is inputted inside the  , it can be traced 15 signals at the same time. Any address can be inputted. As for the R address, the previous 3 positions can be inputted the address before 256; the 4th and 5gh position can be inputted 2 addresses after 255.

(5) (S) start: The signal trace can be performed pressing key after the trace parameter is set correctly.

(T) Stop: Stop the signal trace after controlling the key.

Clear: Clear the value under the cursor pressing the key.

Chapter 2 PLC Programming Operation

2.1 General

GSK990MC PLC's operations are completed in its corresponding window. All modifying the ladder can be executed after getting the authority above the system debugging level..
GSK990MC operations are completed in two main windows:
Press the soft key【**PLCGRA**】twice to enter PLCGRA classification window as Fig.**2-1-1**： **PLCGRA** window includes: basic codes, functional codes, instruction table and edit command.

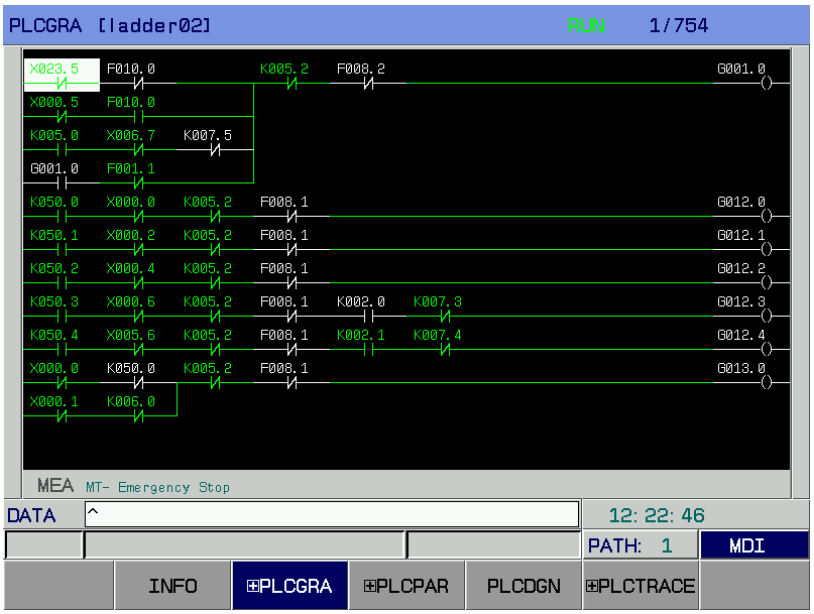


Fig. 2-1-1

PLCPAR window includes: KPAR, TMR, DATA, CTR, MDEC.
Press the soft key【**PLCPAR**】to enter PLCRAR window as Fig.**1-2-3-1.** Press the soft key【**PLCPAR**】to enter the PLCPAR classification operation window as Fi.g **2-1-2.** Modifying the parameter, PLC running control, entering I/O debug mode can be executed after getting the authority above the system debugging level. See **Chapter Three.**

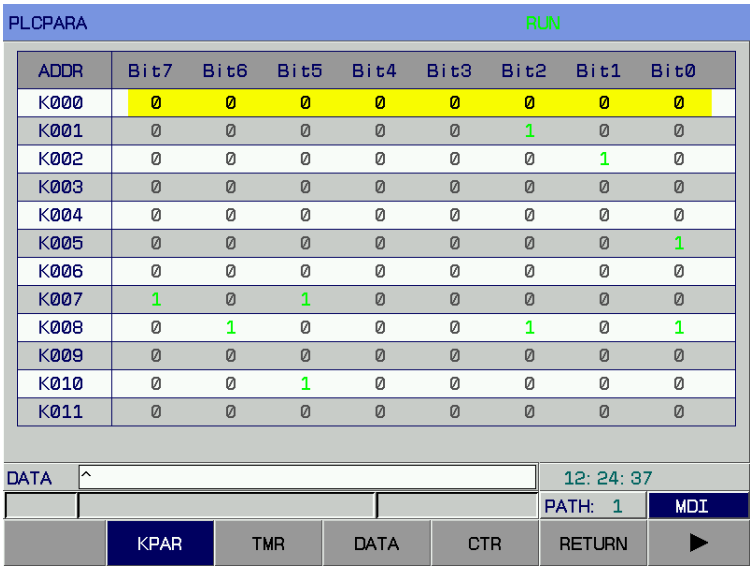


Fig. 2-1-2

2.2 Basic Code

Press the soft key【Basic Command】in Fig. **2-1-1** to enter the basic instruction operation window as **Fig. 2-2-1.**

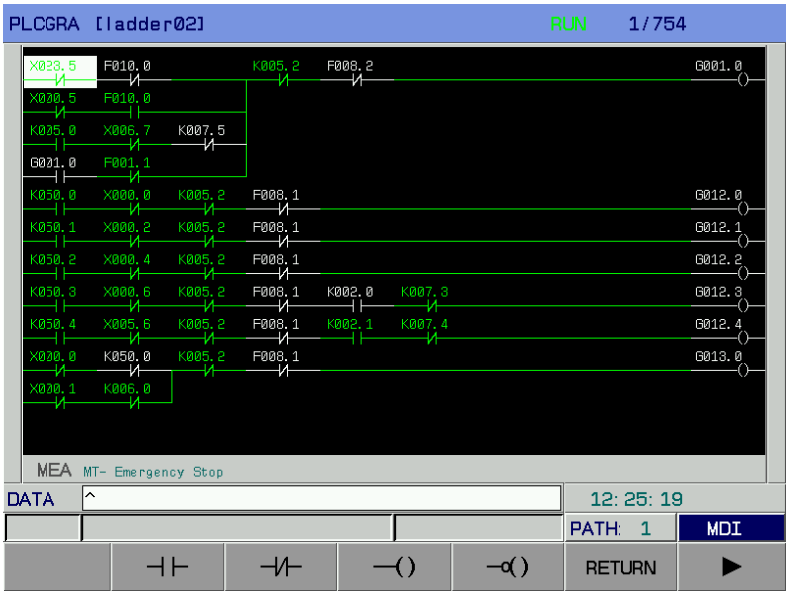


Fig. 2-2-1

Press【▶】to display other basic codes as Fig. **2-2-2**.

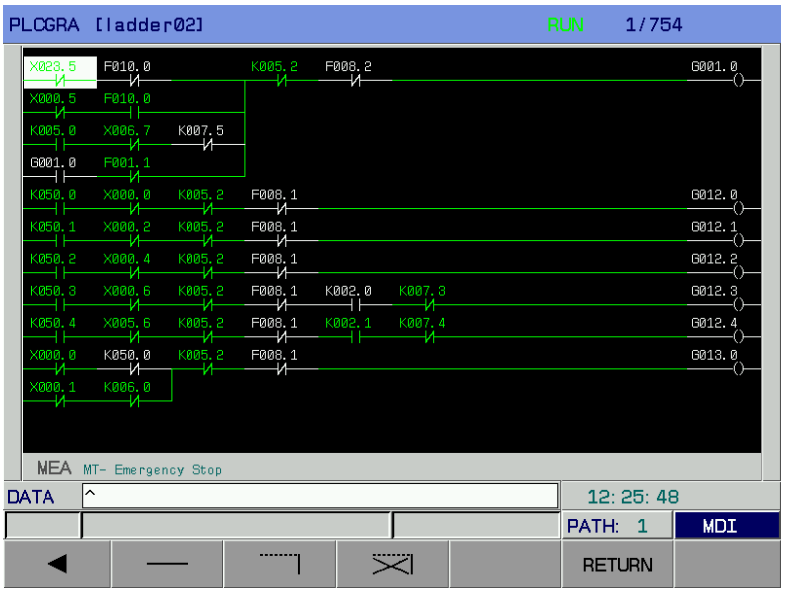


Fig. 2-2-2

Basic codes are divided into 7 kind of graph to display:

【 】 ⊣⊢ normally open contact

【 】 ⊣/⊢ normally-closed contact

【—( )】 : output coil

【—○( )】: output coil reverse

【——】: level conduct line
【 】: vertical conduct line
【 】: delete vertical conduct line
Auxiliary soft key:
【 ▶ 】: Page down page
【 ◀ 】: Page up page
【 Return 】: return to the previous menu

2.3 Ladder Operation Explanation

- Adding an element: position the cursor to the required position, press the corresponding menu to input the element name, press INPUT to confirm the addition after it is displayed behind the data. If the current position has element, the new element replaces the previous one.
- Inserting an element: position the cursor to the required, press INSERT to insert an empty position, and then add the new element as the above method. The cursor can insert orderly.
- Deleting an element: press DELETE to delete the current element
- Adding a vertical conductive line: press 【 】 to add one vertical conductive line under the lower-right of current cursor position.
- Deleting a vertical conductive line: press 【 】 to delete one vertical conductive line under the lower-right of current cursor position.
- Adding a horizontal conductive line: press 【——】to add one horizontal conductive line before the cursor position, if the current position has element, the horizontal conductive line replace the element.
- Inserting a line: position the cursor to the any line of target line, press SHIFT, and then press INSERT, insert the blank line at the place above of the specified line by cursor, and the sequent line will orderly move down one line.
- Deleting a line: position the cursor to the target line, press SHIFT, and then press DELETE to delete the current line, and the sequent line will orderly move up one line.
- Deleting a block: position the cursor to the initial position which will be deleted, Input the

address number of target block's coil, and last press DELETE.

- Search: directly input the required element name, press 【⇧】to search up and press 【⇩】to search down after the data on screen is displayed,

Ladder programming example:

Position the cursor to the initial position of programming, press 【⊣ ⊢】and there is normally-open contact symbol at the cursor position, directly input the element name X1.4 and press INPUT and X1.4 appears at the current cursor position.

Right move the cursor, press【⊣/⊢】, and there is there is normally-open contact symbol at the cursor position, directly input the element name X2.1 and press <INPUT> and X002.1 appears at the current cursor position.

Position the cursor to the initial position of next line, press【 】, there is there is normally-open contact symbol at the cursor position, directly input the element name X2.4 and press INPUT and X002.4 appears at the current cursor position.

Right move the cursor, press 【——】, and draw a horizontal conductive line at the current cursor position.

Move up the cursor, press 【 】, and draw a vertical conductive at the current cursor position.

Press 【—( )】and the system automatic create the output coil, namely the necessary horizontal conductive line. Directly input the element name G1.0, press INPUT and G001.0 appears at the current cursor position.

The programmed ladder is as Fig. 2-3-1:

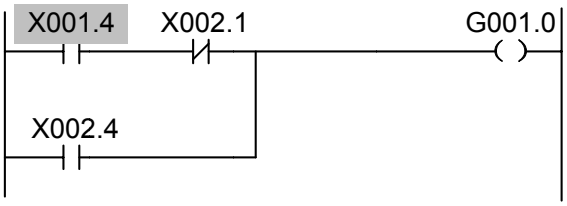


Fig. 2-3-1 Ladder example

Note: The green element in the ladder is turned on no matter that it is normally-open and normally-closed or outputs the coil, and the white indicates it is turned off (owing to the printing, the dark stands it is turned off, and the light stands it is turned on.)

2.4 Function Code

Press 【**F. INST**】in Fig. 2-1-1 to enter the function instruction operation window as Fig. 2-4-1.

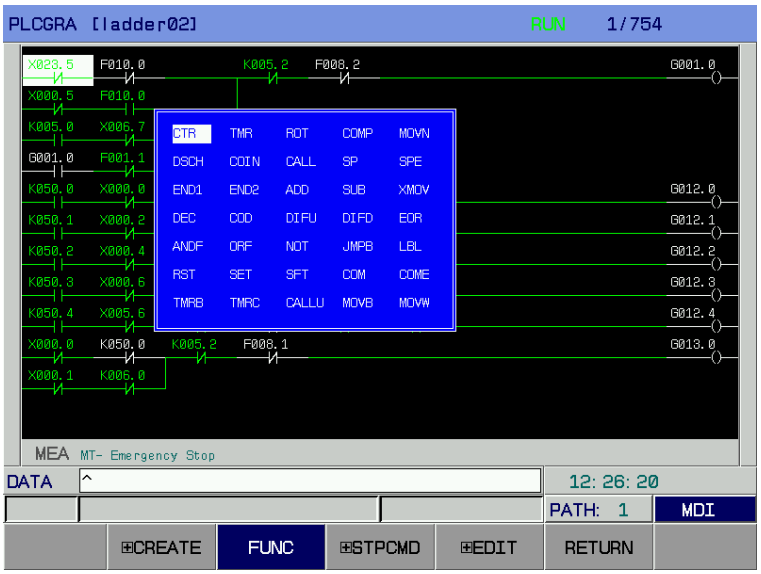


Fig. 2-4-1

There are 35 PLC function instructions in the function instruction list. For the format and use of function instruction, see Programming, and the operation compiling of functional codes are consistent with those of Section 2.3 Ladder Operation.

2.5 Instruction List

Press【指令表】in **PLCGRA** window as Fig.2-1-1 to enter the operation window of instruction classification as Fig. 2-5-1 .

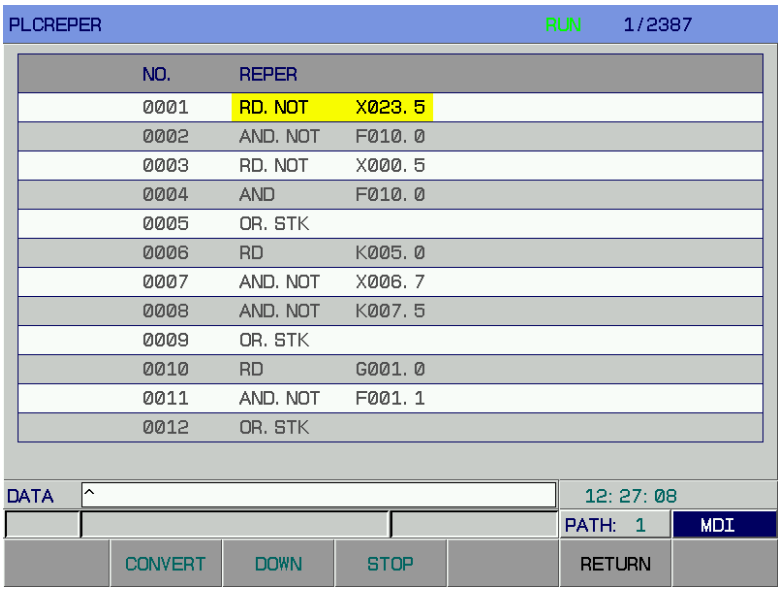


Fig. 2-5-1

Contents and operations of instruction list window:

1/2634: the step number and total step number of current ladder run
RUN: operation state of ladder
Input: display the input data
MDI mode: current operation mode.
【CHANGE】: ladder is changed into instruction list.
【DOWNLOAD】: the instruction list is downloaded to CNC to automatically operate the PLC ladder.
【STOP】: stop ladder running.
【Esc】: return to the previous menu.
Press the Page Up/Page Down, four Direction keys to search and position, view the instruction list address.

2.6 Edit Instruction

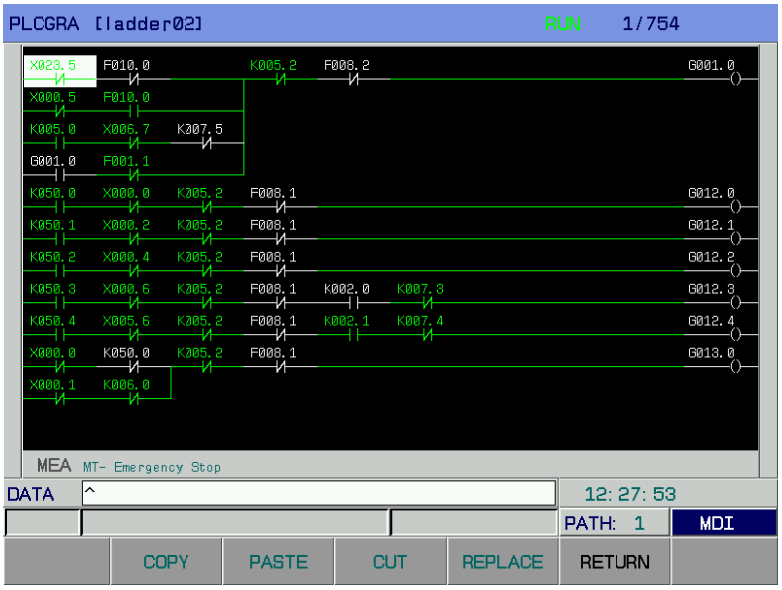


Fig. 2-6-1

Contents and operations on instruction list window:
1/821： displaying the current position of cursor and total line number of ladder
RUN: operation state of ladder
Input: display the input data
MDI mode: current operation mode.
【COPY】 : after inputting G12.1, press it and the ladder between the cursor and G12.1 can be copied.
【PASTE】 : paste the copied ladder.
【DELETE】 : after inputting G12.1, press it and the ladder between the cursor and G12.1 can be deleted.
【CHANGE】 : input the signal address needed to change, and press the key, the system prompts if the address is changed or all addresses are changed.
Y：YES； N：NOT； A：ALL
Press the Page Up/Page Down, four Direction keys to search and position, view the instruction list address.

2.7 PLC Operation Step

PLC operation steps:

1. Press<Setting> key and input the machine manufacturer level password in 【PASSWORD】 window.
2. press<PLC>key, then press 【KPAR】in 【PLCPAR】 window to enter the viewing and setting window of keep relay, operate PLC by modifying the related bit of K000, K001. (Example: setting K000.7 to 1 can modify the ladder after saving). see Appendix K INSTRUCTION List in chapter four Connection for the definition of related bit
3. In【PLCGRA】window, press【INSTRUCTION】to press【STOP】, the system stops the running ladder(if the modified ladder is not the current, the step can be omitted).
4. In 【PLCGRA】 window, complete PLC programming by executing 【B. INST】, 【FUNCTION INST】,【EDIT INST】 etc . Press <SAVE>key, the data field prompts " Ladder Saved!", it means the saving is successful. The corresponding PLC alarms during saving when PLC is mistaken, please check the PLC program.
5. In【PLCGRA】window, press <CHANGE> on the panel then the data field will prompt "CHANGING……", and prompts "CHANGE SUCCEEDED!" after the change finishes.
6. 6. In【PLCGRA】window, click <INSTRUCTION LIST>, then click 【DOWNLOAD】, and the data column prompts "DOWNLOADING……", and "DOWNLOAD SUCCEEDED!" after the download finishes. The ladder is changed into instruction list and downloaded to CNC, then automatically operates.

Chapter 3 PLC Address, Parameter Setting

The addresses and parameters, such as the counter, timer, data list and nonvolatile relay may be used in the PLC; the viewing and setting of these addresses and parameter should be performed in the corresponding window. Press the [⊞PLCPAR] soft key again in the PLCPAR window, then enter the PLC address and parameter setting windows, refer to the Fig. 3-1, which includes the nonvolatile relay, timer, data list, counter, F address corresponding with the M function. It is used for checking and setting these addresses, parameters and data list. (User can set it after the debugging password is input and gained an authority).

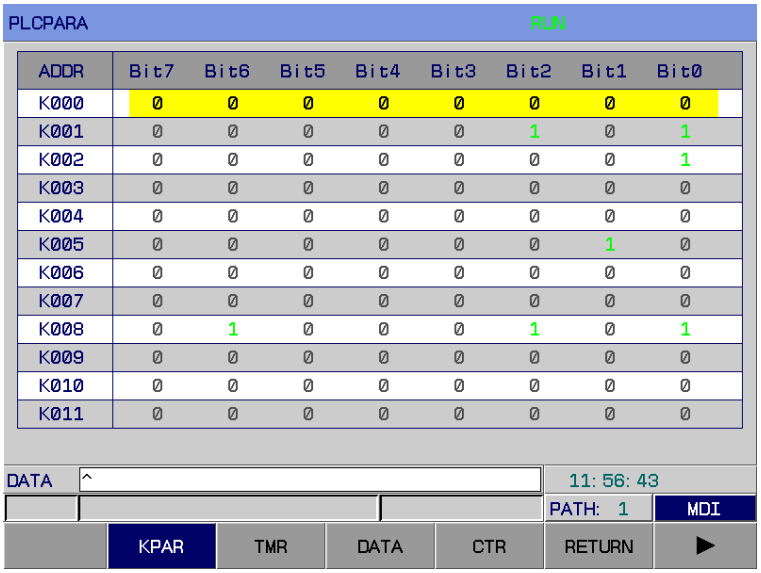


Fig. 3-1

3.1 Nonvolatile/Hold Relay

Press the [KPAR] soft key in the Fig. 3-1, then enter the checking and setting windows of the nonvolatile replay, refer to the Fig. 3-1-1.

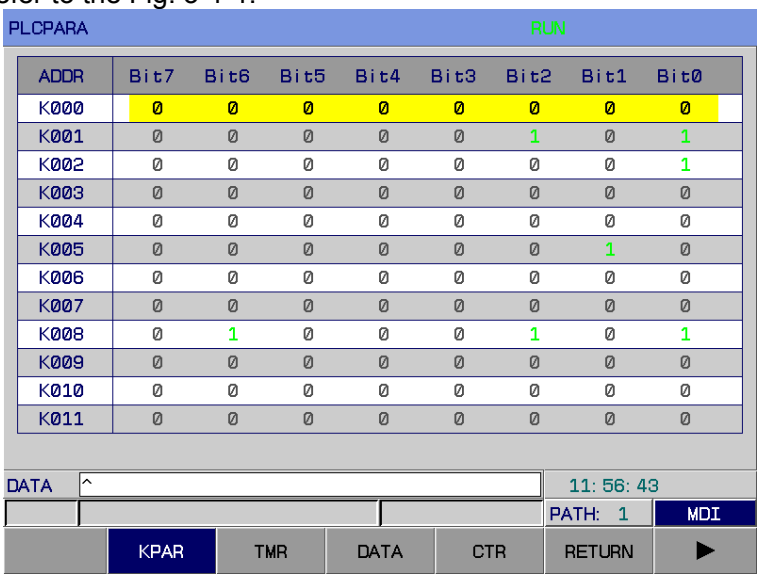


Fig. 3-1-1

The content and operation of the nonvolatile replay window:

RUN: Ladder diagram operation state.
ADDR: Nonvolatile relay address.
Bit0~Bit7: Bit number state of the nonvolatile replay address.
1: This address remains the state before power off after the power is turned off;
0: This address resets on default state after the power is turned off.
Input: Input data display.
MDI mode: Current working mode.
【Return】: Return to the previous menu.
【▶】 : Enter the next page.
After modification, press <Save> key on the panel to download the set value to the CNC run. After the save is successful, the system displays “KPAR downloading successful”; the system displays: “downloading fail” when the save is incorrect; the “illegal downloading parameter” displays without downloading conditions.
(Note: After modification, press <Save> to save it and run it. K000~~K005 are occupied by the system.)
The search and positioning can be performed by the pageup, pagedown and four direction keys on the panel; checking and modifying of the nonvolatile relay address can be performed.

3.2 Timer

Press the [TMR] soft key in the Fig. 3-1, then enter the checking and setting windows of the timer, refer to the Fig. 3-2-1.

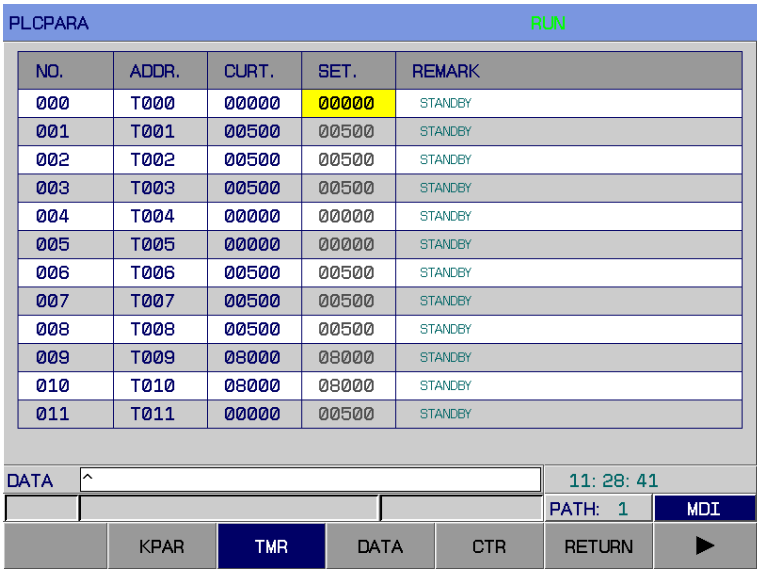


Fig. 3-2-1

The content and operation of the timer:
RUN: Operation state of ladder diagram.
NO: Timer serial number; Do not change.
ADDR.: Timer address; Do not change.
CURT: Current value of the timer; Do not change.
SET: Presetting value of the timer; it can be changed after K000.0 (PLC parameter modification permission) is set to 1.
Input: display the input data
MDI mode: Current working mode
【Return】: Return to the previous menu
【▶】: Enter the next page.
After modification, press <Save> key on the panel to download the set value to the CNC run. After the save is successful, the system displays “TMR downloading successful”; the system displays: “downloading fail” when the save is incorrect; the “illegal downloading parameter” displays without downloading conditions.

The search and positioning can be performed by the pageup, pagedown and four direction keys on the
panel; checking and modifying of the timer can be performed.

3.3 Data List

Press the [DATA] soft key in the Fig. 2-1, then enter the checking and setting window of the data list, refer to the Fig. 3-3-1.

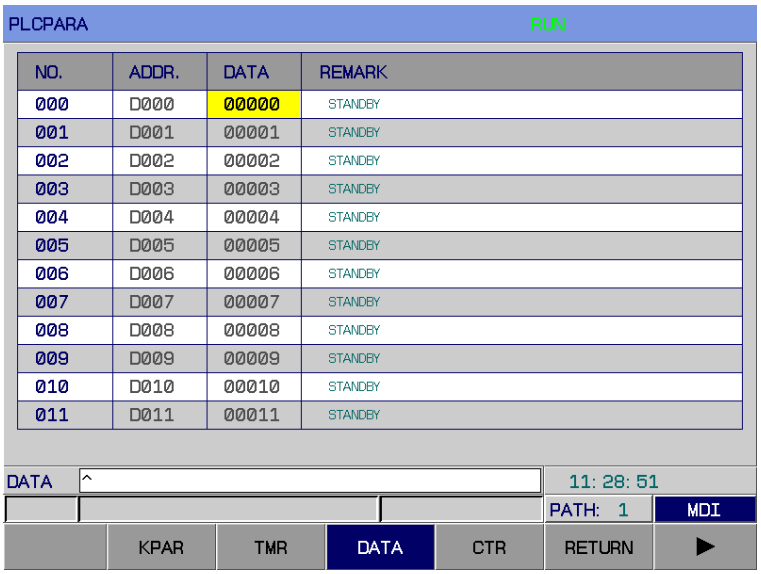


Fig. 3-3-1

The content and operation of the timer:
RUN: Operation state of ladder diagram.
NO: Timer serial number; Do not change.
ADDR.: Timer address; Do not change.
CURT: Current value of the timer; Do not change.
SET: Presetting value of the timer; it can be changed after K000.0 (PLC parameter modification permission) is set to 1.
Input: display the input data
MDI mode: Current working mode
【Return】: Return to the previous menu
【▶】: Enter the next page.

After modification, press <Save> key on the panel to download the set value to the CNC run. After the save is successful, the system displays “TMR downloading successful”; the system displays: “downloading fail” when the save is incorrect; the “illegal downloading parameter” displays without downloading conditions.

Note: After modification, press <Save> to save and run it.

The search and positioning can be performed by the pageup, pagedown and four direction keys on the panel; checking and modifying of the timer can be performed.

3.4 Counter

Press the [CTR] soft key in the Fig. 3-1, then enter the checking and setting window of the counter, refer to the Fig. 3-4-1.

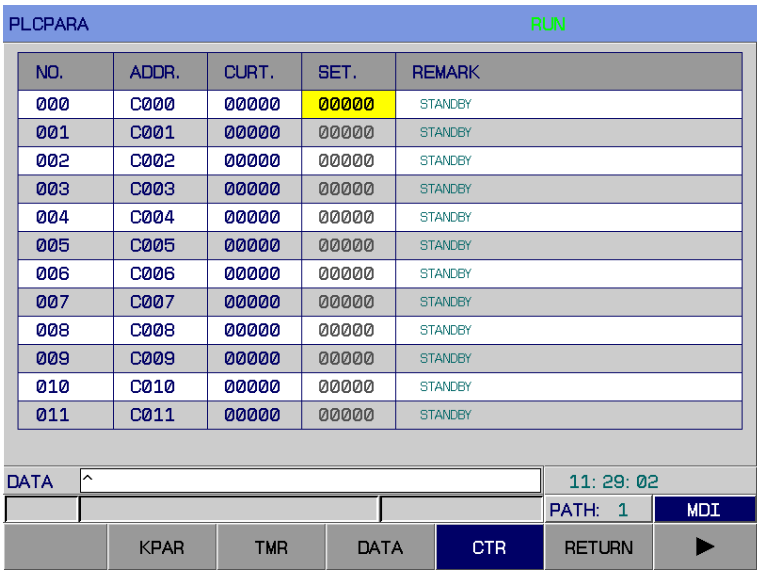


Fig. 3-4-1

The content and operation of the timer:
RUN: Operation state of ladder diagram.
NO: Timer serial number; Do not change.
ADDR.: Timer address; Do not change.
CURT: Current value of the timer; Do not change.
SET: Presetting value of the timer; it can be changed after K000.0 (PLC parameter modification permission) is set to 1.
Input: display the input data
MDI mode: Current working mode
【Return】: Return to the previous menu
【▶】: Enter the next page.

After modification, press <Save> key on the panel to download the set value to the CNC run. After the save is successful, the system displays “TMR downloading successful”; the system displays: “downloading fail” when the save is incorrect; the “illegal downloading parameter” displays without downloading conditions.

Note: After modification, press <Save> to save and run it.

The search and positioning can be performed by the pageup, pagedown and four direction keys on the panel; checking and modifying of the timer can be performed.

3.5 M Function Corresponding to F Address

Press the soft key【▶】 in Fig. 3-1 to enter the next page, press【MDEC】to enter M function corresponding F address’ view and setting pages as Fig. **3-5-1**.

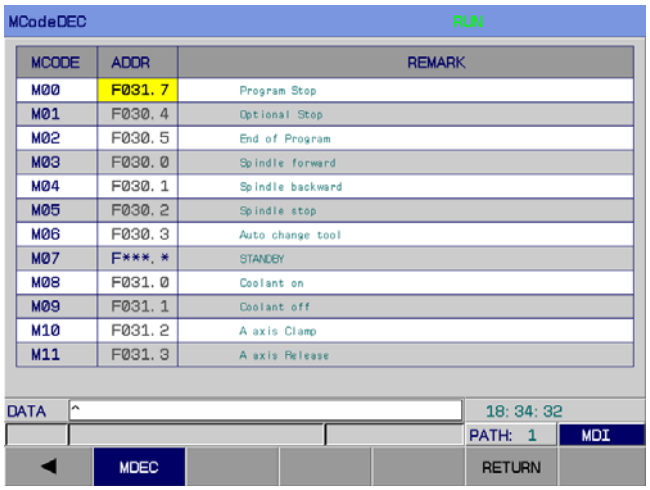


Fig. 3-5-1

Widnow contents and operations of M function corresponding F addresses:
MCodeDEC ： MDEC window.
RUN ： the ladder' run state.
MCODE ： M function number.
ADDR ： F address setting. Input the password which is above the final user's password to modify the address. Turn on the system after modification.
MEANING ： M function explanation.
Input ： display the input data.
MDI mode: current operation mode.
【Return】 ： return to the previous menu.
【◀ 】 ： enter the previous page.
The window is used to register, delete M codes. F signal is set to the only one corresponding M code signal, and M code is invalid when it is set by other F signals.
When M is executed, the corresponding F strobe signal according to the list is sent, the corresponding ladder network is started. After modification, an "Alarm" occurs, it prompts "Turn off the power supply". After the system is turned on, the setting is valid. M function setting apprears in PLC programming, and the corresponding address is modified, the ladder is modified to use the corresponding M code. Such operations must be carefull to avoid the machine damage or persons injury.
The search and positioning can be performed by the pageup, pagedown and four direction keys on the panel; checking and modifying of M function corresponding F address can be performed.
Note 1: M00, M03, M04, M05 are occupied by the system instead of being modified.
Note 2: The system manages the ladder files and its allocated files, the ladder file number must be consistent with the allocated file number. After the user modifies the list, the system saves the modified data to the allocated file corresponding to current run ladder file number, the user should edit again the allocated file's signal meaning, which is convient to the system correctly displaying the user's modification information. The allocated file's Chinese annotation name is "LadChixx"，and its English is "LadEngxx".

Chapter 4 Instructions of The Ladder Diagram Edit Software

4.1 Summary

At present, the GSK990MC system supports the compilation software of the configured GSK ladder diagram.
The compilation software of the GSK ladder diagram is a ladder diagram editor on the PC machine of the GSK GSK990MC and machine center CNC, which mainly offers the functions such as the edit, conversion, debugging and printing of the GSK990MC series ladder diagram. This software can be used in the Windows 98, Windows Me, Windows 2000, Windows XP and Windows 2003.

4.2 Software Introduction

4.2.1 Software Start

The compilation software of the GSK ladder diagram is a green one without being installed, which includes two files (Lad Edit. Exe and Diag.mea) and one folder (LadFile). The Ladder01 file in the LadFile folder is the standard ladder diagram of the system. The software can be operated by clicking Lad Edit. exe twice. When the Ladder01 ladder diagram in the LadFile folder is opened in the software, the window is shown below:

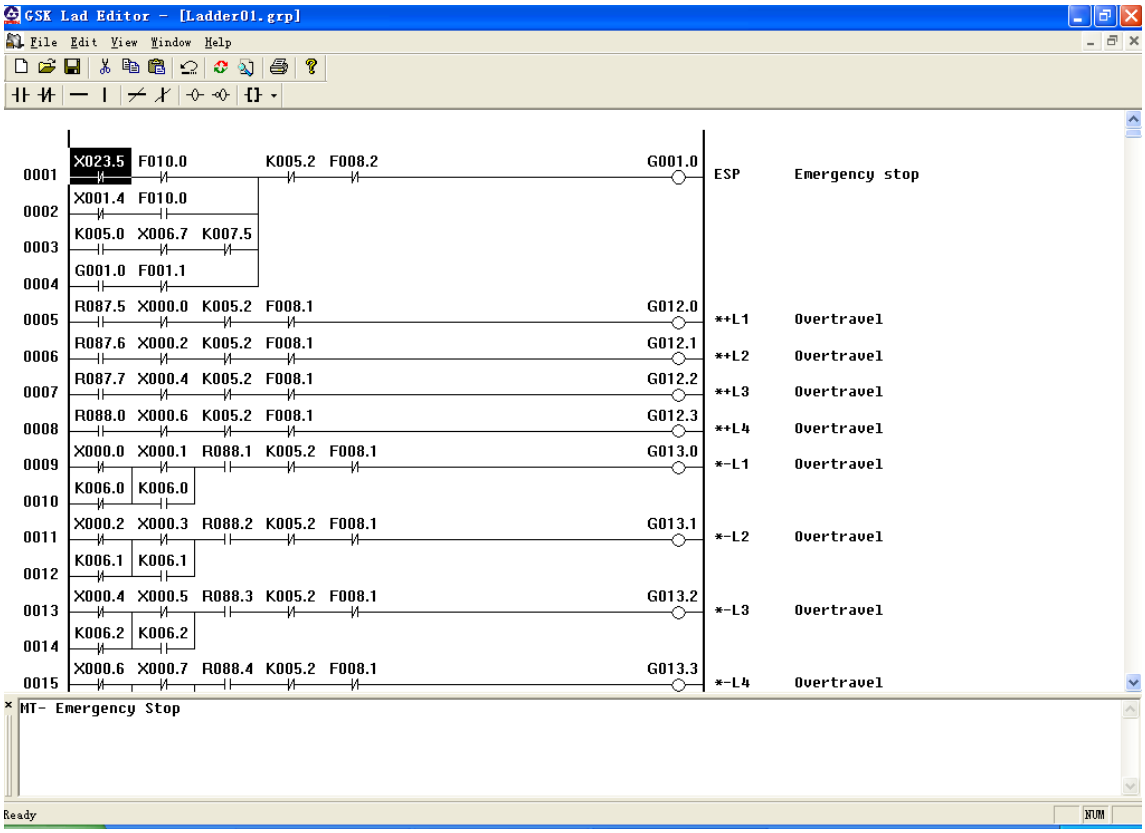


Fig. 4-2-1-1

4.2.2 Function Introduction

- **File menu**

The file menu includes some program files, namely, the new, open and save, which can be produced some functions, such as the performable ladder diagram file or binary system file, printing, printing preview and printing setup and the recently opened file list.

Note: In the "ladder diagram editing" dialog box, each volume of the "ladder diagram version number", "suitable machine" and "ultimate modifier", can be indicated by English, instead of Chinese, otherwise, the error may occur after transferring.

● **Edit menu**

The edit menu includes some functions such as the cutting, copy, pasting, searching, conversion and editing etc.

● **View menu**

Control the display and concealing of the toolbar, state bar, output and instruction list windows.

● **Window menu**

Control the selection and layout of each window.

● **Help menu**

Version information of this software

4.3 Software Operation

4.3.1 Toolbar

There are two toolbars of the main view frame, which are related with the ladder diagram compilation.

4.3.1.1 Main Toolbar

New ladder diagram file

Open the ladder diagram file

Save the ladder diagram file

Cut the selected content to the clipboard

Copy the selected content to the clipboard

Paste content from the clipboard

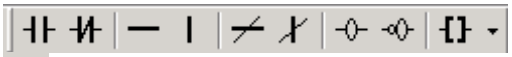
Ladder diagram conversion

Component search

Print the ladder

About the dialog box

4.3.1.2 Editing Toolbar



Insert the normally opened contact

Insert the normally closed contact

Insert the horizontal breakover line

Insert the vertical breakover line (place at the lower right corner of the cursor)

Delete single cell or horizontal breakover line

Delete the vertical breakover line at the lower right corner of the component

Insert the input coil

Insert the output coil reverse

Function code button: There are two methods in the Edit function code:

1. Pop up the drawing menu by click the small arrow at the right, and then select the function codes.

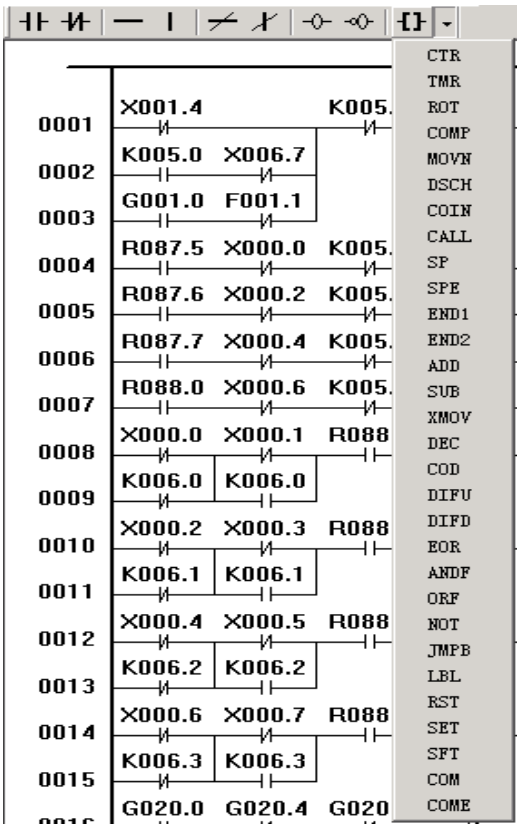


Fig. 4-3-1-2-1

2. Or, click the button icon, set the function code in the function code selection dialog.

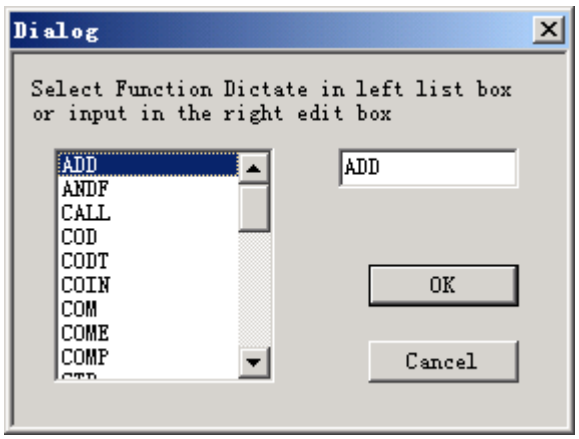


Fig.4-3-1-2-2

4.3.2 Selecting a Figure

In the editing view of the ladder diagram, the black rectangle shadow means cursor, click the left key of the mouse in the figure editing area between two bus cables, and select the position where the figure unit needs to be edited. Refer to the following figure:

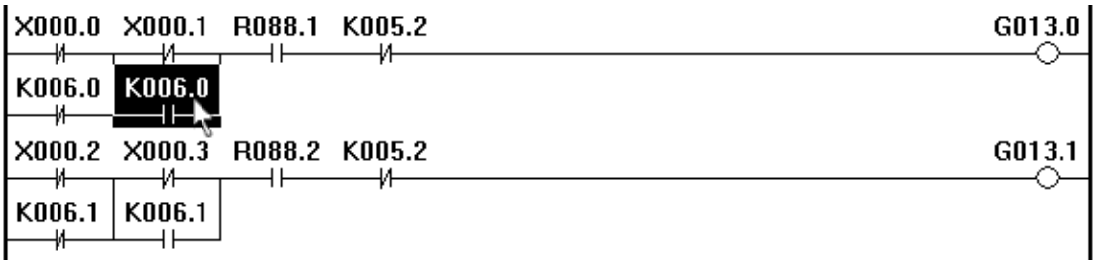


Fig. 4-3-2-1

When the block is selected, press the mouse left key at the beginning position of the block, then drag to the end. The selected area indicates by the rectangle with dotted line before releasing the left key.

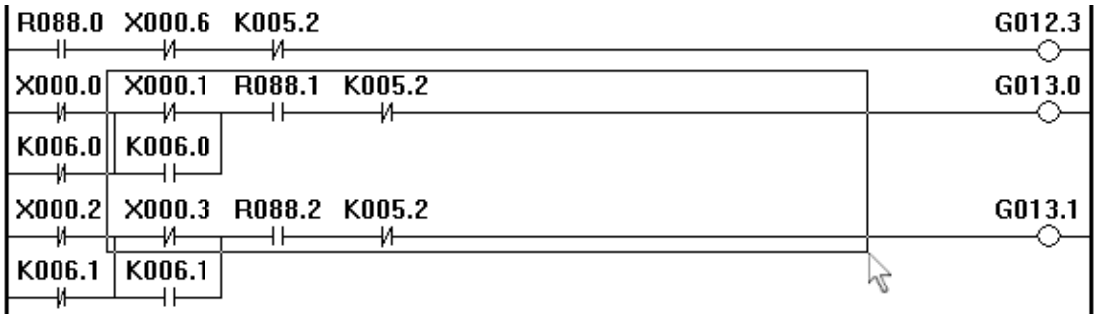


Fig. 4-3-2-2

The inverted color of the whole ladder diagram after releasing, that is, the ladder diagram within this rage is selected, and the next operation can be performed. For example, cutting, deletion and copy etc..

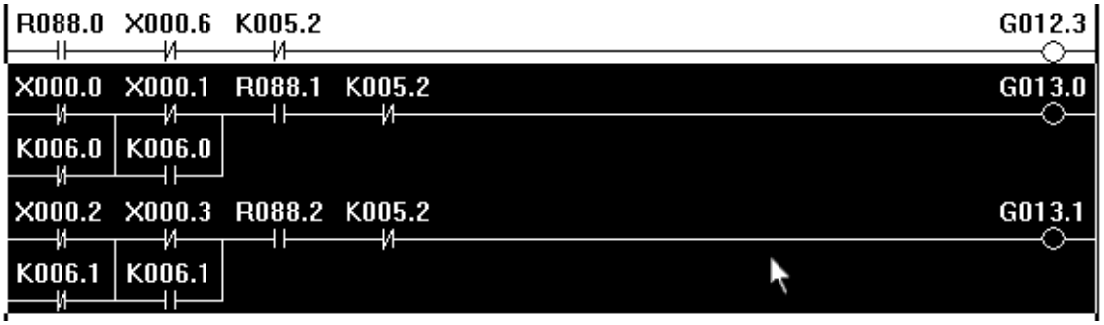


Fig. 4-3-2-3

4.3.3 Editing a Figure

4.3.3.1 Cutting

There are three ways for carrying out this operation after the ladder diagram area to be edited is selected:

1. Select the cutting after springing the environment menu by clicking the right key of the mouse;
2. Select the Edit [Alt+E]--- Cutting [T] of the main menu;
3. Shortcut key [Ctrl+X].

The cut content is placed to the clipboard, which is copied to the ladder diagram by the paste operation.

4.3.3.2 Copy

There are three ways for carrying out this operation after the ladder diagram area to be copied is selected:

1. Select the copy after springing out the environment menu by clicking the right key of the mouse;
2. Select the Edit [Alt+E]--- Copy [C] of the main menu;
3. Shortcut key [Ctrl+C].

The selected content after copying is put to the clipboard, which is copied to the ladder diagram by the paste operation.

4.3.3.3 Pasting

There are three ways for carrying out this operation after the ladder diagram area to be pasted is selected:
1. Select the pasting after springing out the environment menu by clicking the right key of the mouse;
2. Select the Edit [Alt+E]--- Pasting [P] of the main menu;
3. Shortcut key [Ctrl+V].

4.3.3.4 Deletion

There are three ways for carrying out this operation after the ladder diagram area to be deleted is selected:
1. Select the basis code ---- Deletion node after springing out the environment menu by clicking the right key of the mouse once;
2. Click the [Deletion node] button on the editing bar;
3. Shortcut key [Delete];

4.3.3.5 Insertion Line

There are three ways for carrying out this operation after moving the cursor to the position to be inserted the ladder diagram line:
1. Select the insert after springing out the environment menu by clicking the right key of the mouse;
2. Select the Edit [Alt+E]---Insertion line [I] of the main menu;
3. Shortcut key [Insert];

4.3.3.6 Deletion Line

There are three ways for carrying out this operation after moving the cursor to the position to be deleted the ladder diagram line:
1. Select the insert after springing out the environment menu by clicking the right key of the mouse;
2. Select the Edit [Alt+E]--- Deletion line [D] of the main menu;
3. Shortcut key [Ctrl+Delete];

4.3.3.7 Conversion

There are three ways for carrying out this operation after the ladder diagram of the current editing window is converted into the instruction list program:
1. Select the Edit [Alt+E]--- Conversion [V] of the main menu;
2. Click once the [Ladder diagram conveqrsion] button on the editing bar;
3. Shortcut key [F7];

4.3.4 Ladder Diagram Note

4.3.4.1 The Line Note of the Ladder Diagram

Click the left key of the mouse twice out of the bus area at the ladder diagram right; input the notes in the editing frame.

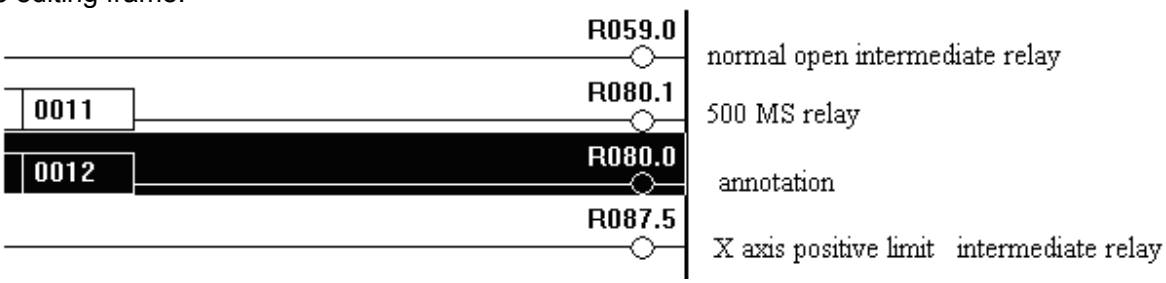


Fig. 4-3-4-1-1

4.3.4.2 Notes of the Ladder Diagram's Component

There are two ways for carrying out this operation after moving the cursor to the position to be modified the ladder diagram component:
1. Click the right key of the mouse after the component is selected; select the modified notes [M] in the springing environment menu;

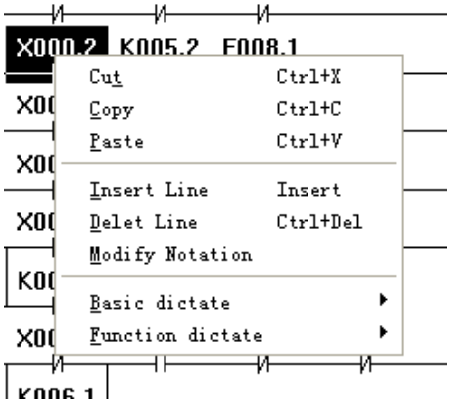


Fig. 4-3-4-2-1

2. Select the edit [Alt+E]----Note modification [M] of the main menu.

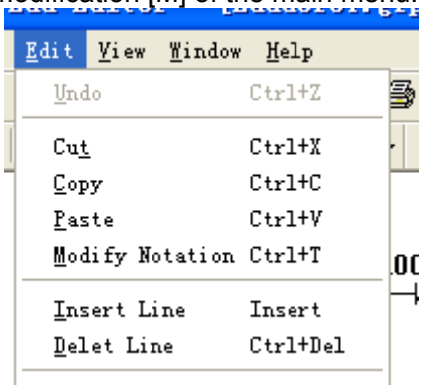


Fig.4-3-4-2-2

3. Shortcut key [Ctrl+T].

Input the notes in the springing dialog box; save it by clicking the OK button.

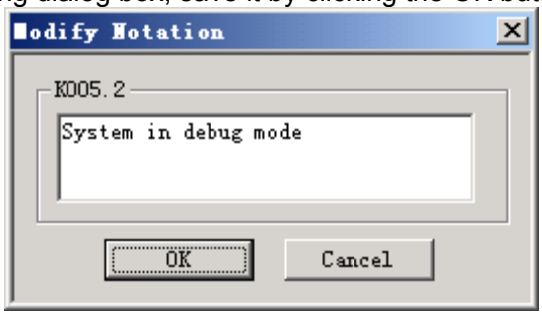


Fig.4-3-4-2-3

The notes saved will be displayed the output window under the screen when the component is selected each time, refer to the following figure:

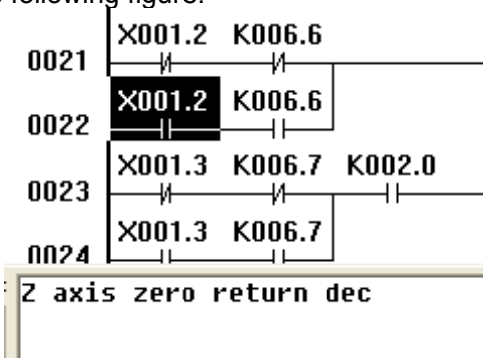


Fig. 4-3-4-2-4

4.3.5 Export

The ladder diagram file should be converted when it is edited and saved, which can be generated the performable file after converting, and then transfer to the CNC using the serial-port communication

software or U disk that it is performed by the PLC from the CNC system. Refer to the ***Chapter 11 System Communication, GSK990MC Programming and Operation User Manual***.
The ladder diagram file is then produced.
Select the file [Alt+F]----Ladder diagram file producing [L] of the main menu, save it after inputting the name and path, the ladder diagram file with the extension name ".grp" is produced, which can be used in GSK990MC.
The ladder allocated with a file format is shown in Appendix 2.

III Function

Chapter 1 Controlled Axis

1.1 Output Signal of Controllable Axis

General The movement state of each axis can be output to the PLC.
Signal Axis movement signal
MV1～MV4 （F017#0～F017#3）
[Type] Output signal
[Function] These signals are indicated that one controllable axis is being moved.
MV1: the 1st axis is moving
MV2: the 2nd axis is moving
MV3: the 3rd axis is moving
MV4: the 4th axis is moving_
[Output condition]
The signal turns into 1 in the following case:
The corresponding axis has been moved.
The signal turns into 0 in the following case:
The corresponding axis has been stopped.
Signals of the axis movement direction
MVD1~MVD4（F019＃0~F019＃3）
[Type] Output signal
[Classification] These signals indicate the movement direction of controlled axis.
MVD1：movement direction signal of the 1st axis
MVD2：movement direction signal of the 2nd axis
MVD3：movement direction signal of the 3rd axis
MVD4：movement direction signal of the 4th axis
［Output conditions］
“0” indicates the corresponding axes are negatively moving,
“1” indicates the corresponding axes are positively moving.
Caution:
These signals maintain their condition during a stop, indicating the direction of the axes’ movement before stopping.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F017					MV4	MV3	MV2	MV1
F019					MVD4	MVD3	MVD2	MVD1

1.2 Servo Ready Signal

Signal servo ready signal
SA（F000#6）
［Classification］ Output signal
［Function］ After the servo is ready, SA signal becomes 1. For the axis with absorption brake, release the brake when outputting the signal， execute the brake when the system does not output the signal.
Signal address:

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
F000		SA						

Chapter 2 Preparation for Operation

2.1 Emergency Stop

General If you press Emergency Stop button on the machine operator's panel, the machine movement stops in a moment.

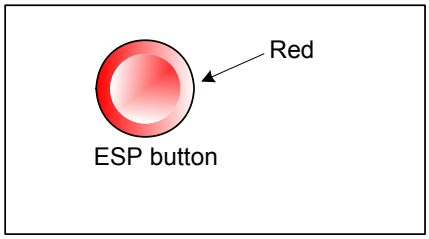


Fig. 2-1

The button is locked when it is pressed, although it varies with the machine to builder, the button can usually be unlocked by twisting it right.

Signal Emergency stop signal
ESP （ G001.0 ）
［Classification］ Input signal
［Function］ Activating an emergency stop signal stops the machine instantly.
［Operation］When the emergency stop *ESP becomes 1, the emergency stop is applied to the machine and the CNC is reset.

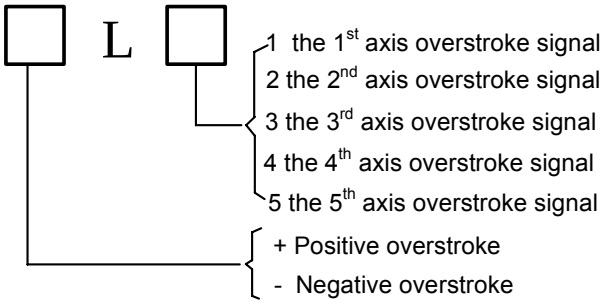
Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G001								ESP

2.2 CNC Overtravel Signal

General When the tool tries to move beyond the stroke end set by the machine tool limit switch, the tool decelerates and stops as a result of tripping the limit switch, and an Over TRAVEL is displayed. The signal can be output with an alarm.

Signal Overtravel signal
＋L1～＋L4 (G012#0~G012#3)
－L1～－L4 (G013#0~G013#3)
［Classification］ Input signal
［Function］Indicates that the control axis has reached its stroke limit. There are individual signals for each direction in every control axis. The + /- in the signal name indicates the direction and the number corresponds to the control axis.


L
1 the 1st axis overstroke signal
2 the 2nd axis overstroke signal
3 the 3rd axis overstroke signal
4 the 4th axis overstroke signal
5 the 5th axis overstroke signal
+ Positive overstroke
- Negative overstroke

［Operations］ when the signal becomes "0": the controlled unit operates as follows:
* Automatic operation: If even one axis overtravel signal becomes 1, all axes are decelerated to stop, an alarm is given and operation is halted.

* Manual operation: Only the axis whose overtravel signal has become 1 is decelerated to a stop, and the axis can be moved in the opposite direction.

*Once the axis overtravel signal has become 1, the axis direction is registered. Even if the signal returns to 0, it is not possible to move that axis in that direction until the alarm is cleared.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G012					+L4	+L3	+L2	+L1
G013					−L4	−L3	−L2	−L1

2.3 Alarm Signal

General When an alarm is triggered in the CNC, the alarm is displayed on the screen, and the alarm signal is set to 1.

Signal Alarm signal

AL（F001＃0）

AL（F001＃0）

［Classification］ Output signal

［Function］ Alarm signal reports CNC is in an alarm state as follows:

P/S alarm

Overtravel alarm

Servo alarm

［Output conditions］These alarm signals are set to 1 when:

——The CNC is placed in the alarm state.

These alarm signals are set to 0 when:

——The alarm has been released by resetting the CNC.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F001								AL

2.4 Operation Mode Selection

Signal Run mode check signal

F003#0~F003#7

[Classification**]** Output signal

[Function] indicate the currently selected run mode

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F003	MZRO	MEDT	MMEM	MRMT	MMDI	MJ	MH	MINC

2.5 Status Output Signal

Cutting feed signal

CUT（F002＃6）

［Classification］ Output signal

［Function］ These signals indicate that the cutting feed is being performed by automatic operation.

［Output conditions］ These signals are 1 when:

Cutting feed is being performed by automatic operation (cutting feed for linear interpolation, circular interpolation, helical interpolation, thread cutting, skip cutting).

Note:

1. Do not output the signal in the state of feed hold.

2. Output the signal during the interlock or the feedrate override is set to 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F002		CUT						

Chapter 3 Manual Operation

3.1 JOG Feed/Incremental Feed

General

JOG feed In JOG mode, setting a feed axis and direction selection bit to 1 on the machine operator's panel moves the machine along the selected axis in the selected direction.

Incremental feed In incremental feed mode, setting a feed axis and direction selection bit to 1 on the machine operator's panel moves the machine one step along the selected axis in the selected direction. The minimum distance the machine moves, is the least input increment. The step can be 10, 100, or 1000 times the least input increment.

The only difference between JOG feed and incremental feed is the method of selecting the feed distance. In JOG feed, the machine continues to be fed while the following signals selecting the feed axis and direction are 1: ＋J1，－J1，＋J2，－J2，＋J3，－J3，＋J4，－J4，etc. In incremental feed, the machine is fed by one step. Using JOG feedrate override dial can regulate JOG feedrate. The machine moves at the rapid traverse speed by the rapid feedrate selection switch, which is irrelevant with the JOG feedrate override signal. The step distance can be selected by the incremental step G026＃4~G026＃5.

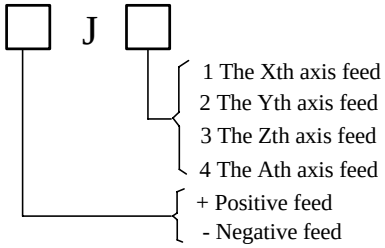
Signal Feed axis and direction selection signal

＋J1~＋J4（G27＃0~G27＃3）

－J1~－J4（G28＃0~G28＃3）

［Classification］ Input signal

［Function］ In JOG feed or Incremental feed mode, select the required feed axis and direction. +/- in the signal name indicates the feed direction, the number corresponds to the controlled axis.



［Operation］ When the signal is set to 1, the control unit operate as follows:

* When JOG feed or incremental feed is allowed, the control unit moves the specified axis in the specified direction.

When the signal is set to 1 in JOG feed, the control unit continues to move that axis,

* In incremental feed, the control unit feeds the requested axis by the step distance which is specified by the manual handle feed move distance selection signal, then the axis stops. Even if the signal is set to 0 while the axis is being fed, the control unit does not stop moving. To feed the axis again set the signal to 0, then to 1 again.

Manual rapid traverse selection signal

RT（G024＃7）

［Classification］ Input signal

［Function］ Select the rapid traverse rate in MANUAL feed or incremental feed mode.

［Use］ When the signal becomes 1, the control unit operates as follows:

The control unit executes the MANUAL feed or incremental feed at a rapid traverse rate. The rapid traverse override is valid.

When the signal is switched from 1 to 0 or vice versa in MANUAL feed or incremental feed, the feedrate is decelerated until it reaches zero, then increased to the specified value. During acceleration and deceleration, the feed axis and direction selection signal can be kept 1.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G024	RT							
G027					+J4	+J3	+J2	+J1
G028					－J4	－J3	－J2	－J1

3.2 MPG / Step Feed

General In MPG/Step feed mode, the machine moves by rotating the manual pulse generator(MPG) or Step. Select the axis along which the machine moves with the MPG feed axis selection signal/axis move signal.

Signal MPG/Step feed amount selection signal
（G026＃4~G026＃5）

［Classification］ Input signal

[Function］ MPG/Step feed movement amount selection signal

This signal uses two G signals to perform binary coding, which means the movement distance per step.

MPG/Step feed amount selection signal		MPG		Step	
MP1	MP2	mm	inch	mm	inch
0	0	0.001	0.0001	0.001	0.0001
1	0	0.01	0.001	0.01	0.001
0	1	0.1	0.01	0.1	0.01
1	1	——	——	1	0.1

Note: G26.4, G26.5 being 1 in MPG mode does not exist.

Chapter 4 Reference Point Return

4.1 Manual Reference Point Return

General In manual reference point return mode, the machine tool move in the specified direction by setting the position parameter N0：7#0~#3 to execute the reference point return. The selected axis on the panel reports the axis to execute the mechanical zero return, which is not related to the move direction of axis.
The following signals are related to the manual reference point return:

Table 4-1-1

Signal	Manual reference point return
Reference point return deceleration signal	DECX, DECY, DECZ, DEC4
Reference point return completion signal	ZP1, ZP2, ZP3, ZP4

Signal
Reference point return completion signals
ZP1～ZP4(F016＃0~F016＃3)
［Classification］ Output signal
［Function］ These signals report that the machine tool is at the reference point on a controlled axis. These signals correspond separately to all axes.

Table 4-1-2

ZP1	The 1st axis reference point return completion signal
ZP2	The 2nd axis reference point return completion signal
ZP3	The 3rd axis reference point return completion signal
ZP4	The 4th axis reference point return completion signal

［Output conditions］When these signals becomes 1:
Manual reference point return is completed and the current position is in the in-position area.
The automatic reference point return(G28) is completed and the current position is in the in-position area.
The reference point return check is completed and the current position is in the in-position area.
When the signal becomes 0:
The machine tool moves from the reference point.
The emergency stop signal appears.
The servo alarm appears.
Reference point return deceleration signal check
DECX（G017＃0）DECY（G017＃1） DECZ（G017#2）DEC4（G017#3）
［Classification］ Input signal
［Function］These signals decelerate the feedrate for manual reference point return to a low feedrate in order to approach the reference point at the low feedrate.

4.2 Reference Point Return Check Signal

The 1st reference point check permission signal
PREF10---PREF13 （G056#0----#3）
The 2nd reference point check permission signal
PREF20---PREF23 （G057#0----#3）
The 3rd reference point check permission signal
PREF30---PREF33 （G058#0----#3）
The 4th reference point check permission signal
PREF40---PREF43 （G059#0----#3）

［Classification］ Input signal

［Function］ When the signal is set to 1, the reference point return completion signal (F42, F43, F44) is valid.

These signals separately corresponds to these signals.

Table 4-2-1

PREF*0	The 1st reference point check permission signal
PREF*1	The 2nd reference point check permission signal
PREF*2	The 3rd reference point check permission signal
PREF*3	The 4th reference point check permission signal

The 1st reference point return completion signal
ZP11---ZP14 （F041#0---#3）
The 2nd reference point return completion signal
ZP21---ZP24 （F042#0---#3）
The 3rd reference point return completion signal
ZP31---ZP34 （F043#0---#3）
The 4th reference point return completion signal
ZP41---ZP44 （F044#0---#3）

［Classification］ Output signal

［Function］ These signals report that the machine tool is at the reference point on a controlled axis.

These signals correspond separately to all axes.

Table 4-2-2

ZP*1	X axis reference point return completion signal
ZP*2	Y axis reference point return completion signal
ZP*3	Z axis reference point return completion signal
ZP*4	A axis reference point return completion signal

［Output conditions］ the signal is enabled when it is the reference point check permission signals(G57, G58, G59) become 1.

When these signals becomes 1:

Manual reference point return is completed and the current position is in the in-position area.

The automatic reference point return(G30) is completed and the current position is in the in-position area.

The reference point return check is completed and the current position is in the in-position area.

When the signal becomes 0:

The reference point check permission signal (G57, G58,G59 become 0,

The machine tool moves from the reference point.

The emergency stop signal appears.

The servo alarm appears.

4.3 Area Check Signal

Area check signal

AQ1—AQ3 (F045#0---#2)

［Type］ Output signal

［Function］These signals report that the machine tool is at the reference point on a controlled axis.

These signals correspond separately to all axes.

Table 4-3-1

AQ1	The 3rd axis' the 2nd reference point area check signal
AQ2	The 3rd axis' the 3rd reference point area check signal
AQ3	The 3rd axis' the 4th reference point area check signal

［Output conditions］

When the machine is in the stored travel check 1(the data parameter set **P66~P73** the limit, and outside the stored travel check 2 (the data parameter **P76~P83** or program command can set the limit of this side), the signal becomes 1, otherwise becomes 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F016					ZP4	ZP3	ZP2	ZP1
F041					ZP14	ZP13	ZP12	ZP11
F042					ZP24	ZP23	ZP22	ZP21
F043					ZP34	ZP33	ZP32	ZP31
F044					ZP44	ZP43	ZP42	ZP41

	#7	#6	#5	#4	#3	#2	#1	#0
F045						AQ3	AQ2	AQ1
G017					DEC4	DECZ	DECY	DECX
G056					PREF13	PREF12	PREF11	PREF10
G057					PREF23	PREF22	PREF21	PREF20
G058					PREF33	PREF32	PREF31	PREF30
G059					PREF43	PREF42	PREF41	PREF40

Chapter 5 Automatic Operation

5.1 Cycle Start/Feed Hold

General
Start of automatic (Cycle start) When automatic operation start signal ST is set to 1 then 0 while the CNC is in memory mode, DNC operation mode or MDI mode, the CNC enters the automatic operation start state then starts operating.
The signal ST is ignored as follows:
When the CNC is in other modes except for Auto or MDI mode.
When the feed hold signal (*SP) is set to 1.
When the emergency stop signal (*ESP) is set to 1.
When the reset & tape rewinding signal RRW is “1”.
When <RESET> on MDI panel is pressed.
When CNC is in the state of alarm.
When the automatic operation is started.
When the program restart signal (SRN) is set to 1.
When CNC is searching one sequence number.
In automatic operation, the CNC enters the feed hold and stops running as follows:
1. When the feed hold signal (*SP) is set to 1.
2. The single block instruction is end when the single block is running.
3. MDI operation is completed.
4. CNC alarms.
5. The single block instruction is end after the mode is changed to others or Edit mode.
In automatic operation, the CNC enters the reset and stops running as follows:
When the emergency stop signal (*ESP) is set to 1.
2. When <RESET> on MDI panel is pressed.
Halt of automatic operation
（Feed hold） When the feed hold signal *SP is set to 0 in automatic operation, the CNC enters the feed hold state and stops operation. At the same time, cycle start lamp signal STL is set to 0 and feed hold lamp signal SPL is set to 1. Re-setting signal SP to 0 in itself will not restart automatic operation. To restart automatic operation, first set signal SP to 0, then set signal ST to 1 and to 0.

Signal Cycle start signal
ST（G023＃6）
［Classification］Input signal
［Function］Start the automatic operation.
［Operation］In Auto, MDI mode, ST has checked the fall edge, the CNC enters the cycle start state and starts operations.
Feed hold signal
SP（G023＃7）
［Classification］Input signal
［Function ］ Halt the automatic operation
［Operation］ In Auto mode, SP signal position checks the fall edge, CNC enters the feed hold and stops running. When SP signal is set to 0, the automatic operation does not start.
Cycle start lamp signal
STL（F000＃5）
［Classification］ Output signal
［Function］ The signal reports PLC that the automatic operation start is entered.
［Output conditions］The signal is set to 1 or 0, which is determined by CNC state as Table 5-1.
Feed hold lamp signal
SPL（F000＃4）
［Classification］Output signal
［Function］The signal reports PLC that the feed hold is entered.

［Output conditions］The signal is set to 1 or 0, which is determined by CNC state as Table 5-1.

Automatic operation signal

OP（F000＃7）

［Classification］Output signal

［Function］ The signal reports PLC that the automatic operation is entered.

［Output conditions］ The signal is set to 1 or 0, which is determined by CNC state as Table 5-1.

Table 5-1

	Cycle start lamp STL	Feed hold lamp SPL	Automatic operation lamp OP
Cycle start	1	0	1
Feed hold	0	1	1
Automatic operation stopping	0	0	0
Reset	0	0	0

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G023	SP	ST						
F000	OP		STL	SPL				

5.2 Reset

General CNC is reset and enters the reset state in the following conditions：

1. When the emergency signal (*ESP) is set to 1.
2. When <RESET> on MDI panel is pressed.

When the CNC is reset, the resetting signal RST is output to the PLC. The resetting signal RST is set to 0 when the resetting signal output time, set by No. 203, has elapsed after the above conditions have been released.

RST＝T_{reset}（Reset processing time）＋parameter setting value by No. 203

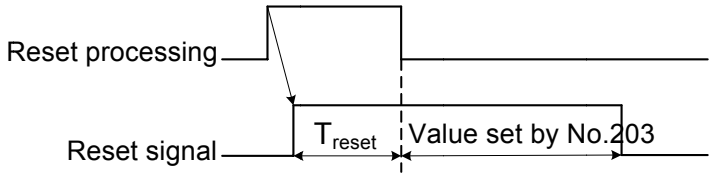


Fig. 5-2

When the CNC is reset in automatic operation, the automatic operation is stopped and movement axis is decelerated and stopped.

When the CNC is reset during the execution of the M, S, T function, signal MF，SF or TF is set to 0 within 16ms.

RST（F001＃1）

［Classification］Output signal

［Function］The signal reports PLC that CNC is reset.

［Output conditions］ The signal is set to 1 when:

1: When the emergency stop signal (ESP) is set to 1.
2: When <RESET> on MDI panel is pressed.

The signal is set to 0 when:

When the reset signal output time set by No. 203 is completed after the above are released and CNC is reset.

Singal address

	#7	#6	#5	#4	#3	#2	#1	#0
F001							RST	

5.3 Testing a Program

General Before machining is started, the automatic running check can be executed. It checks whether the established program can operate the machine as desired. This check can be accomplished by running the machine or view the position display change without running the machine.

5.3.1 Machine Tool Lock

General The change of the position display can be monitored without moving the machine.
When all-axis machine lock signal MMLK is set to 1, output pulses to the servo motors are stopped in manual or automatic operation. The instructions are distributed, however, updating the absolute and relative coordinates. The operator can therefore check if the instructions are correct by monitoring the position display.

All-axis machine lock signal
MMLK（F004＃1）

［Classification］Output signal

［Function］The signal reports PLC of the state of all-axis machine tool lock signal.

［Output condition］When the signal is set to 1, all-axis machine tool lock signal is set to 1.
When the signal is set to 0, all-axis machine tool lock signal is set to 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
F004							MMLK	

5.3.2 Dry Run

General Dry run is valid only for automatic, MDI operation. The machine moves at a constant feedrate regardless of the feedrate specified in the program. The feedrate is set by P86.
This function is used to check the movement of the machine without a workpiece.

Signal Dry run signal
DRN（G021＃2）

［Classification］Input signal

［Function］ Enables dry run.

［Operation］When the signal is set to 1, the machine tool moves at the feedrate specified for dry run.
When the signal is 0, the machine tool normally moves.

Note:
When the dry run signal becomes from 0 to 1 during the movement of the machine, the machine run speed accelerates or decelerates at the speed specified by the program to the dru run speed; when the dry run signal becomes 0 from 1, the machine run sped accelerates or decelerates to the speed specified by the program.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G021						DRN		

5.3.3 Single Block

General When the single block signal (SBK) is set to 1 in Auto, MDI mode, the CNC enters the automatic operation stop state after executing the current block. In subsequent automatic operation, the CNC enters the automatic operation stop state after executing each block in the program. When the single block signal (SBK) is set to 0, normal automatic operation is stored.

Signal Single block signal

SBK（G021＃1）

［Classification］ Input signal

［Function］ Enables single block operation.

［Operation］ Execute the single block when the signal is set to1.

Execute the normal operation when the signal is set to 0.

Single block check signal

MSBK（F004＃3）

［Classification］ Output signal

［Function］ The signal reports PLC of the state of single block signal.

［Operation］ The signal is set to 1 as follows:

——When the single block signal SBK is set to1.

The signal is set to 0 as follows:

——When the single block signal SBK is set to 0.

Note:

1. Operations in thread cutting.

When the SBK signal becomes 1 during the thread cutting and the thread cutting code is executed, the operation stops at the 1st non thread cutting block.

2. Operations in fixed cycle.

After SBK signal is set to 1 during the fixed cycle, it stops when each positioning approaches the drilling hole and the tool retraction is performed, it does not stop at the end of block. When STL signal is set to 0, SPL signal becomes 1, which means the tool does not reach the end of block. After a block is completely executed, STL and SPL signal become 0 and the operation stops.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G021							SBK	
F004					MSBK			

5.4 Optional Block Skip

General When a slash followed by a number is specified at the head of a block, and optional block skip signal BDT is set to 1 during automatic operation, the block is ignored**.**

Signal Skip optional block signal

BDT（G021#0）

［Classification］ Input signal

［Function］ Select whether a block with “/” is neglected.

［Operation］ During automatic operation, when BDT is 1, the block with “/” is neglected.

The program is normally executed when BDT is 0.

Optional block skip check signal

MBDT（F004#0）

［Classification］ Output signal

［Function］The signal reports PLC of the state of skip optional block BDT.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G021								BDT

F004								MBDT

5.5 Program Restart

General A program may be restarted at a block by specifying the sequence number of the block, after automatic operation is stopped because of a broken tool or for holidays.

Program restart signal

SRN<G021#6>

[Classification] Input signal

[Function] Select the program restart

[Operation] When the program restart signal is set to 1 to search for the sequence number of the block to be restarted, the CRT screen changed to the program restart screen. When the program restart signal is set to 0, and automatic operation is activated, the machine moves back to the machining restart point at dry run speed along the axes one by one. When the machine moves to the restart point, machining restarts.

Signal during program restart

SRNMV<F002#4>

[Classification**]** Output signal

[Function**]** Report the program is started.

[Output conditions**]** The signal becomes 1 when:

— When G21#6 is 1 in automatic mode, the program restarting signal is set to 1.

The signal becomes 0 when :：

—The program restart sequence ends(all controlled axes of machine tool moves to the restart point).

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G021		SNR						
F002				SRNMV				

Chapter 6 Feedrate Control

6.1 Rapid Traverse Rate

General The 4 gears (F0，25％，50％， 100%) can be used for rapid traverse rate.

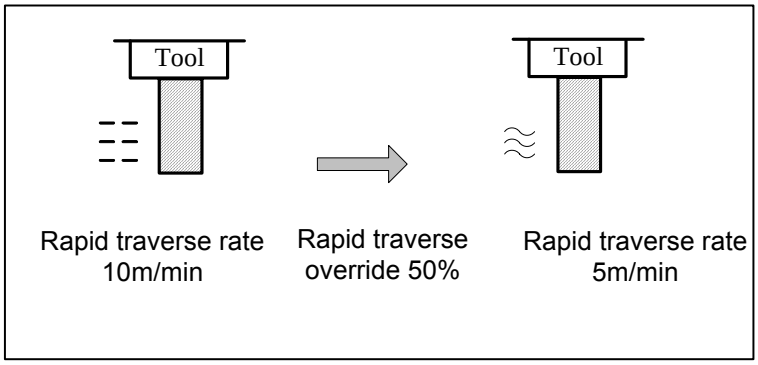


Fig. 6-1

Feedrate: Actual moving speed is obtained by multiplying the override value by the value set by the data parameter P088~091 either in the auto mode or manual operation mode (including manual reference point return and program zero return).

F0: It is set by the data parameter P093.

Signal rapid traverse override coded signal（G11#0~G11#1）

［Classification］ Input signal

［Function］ It is the rapid traverse override signal

［Operation］ The coded signal is corresponded to the following override

Rapid traverse override coded signal		Override value
RV1	RV2	
1	1	100%
0	1	50%
1	0	25%
0	0	F0

6.2 Feedrate Override

General A programmed feedrate can be reduced or increased by a percentage selected by the override dial. This feature is used to check a program. For example, when a feedrate of 100 mm/minute is specified during the program, setting the override to 50% to move the tool at 50 mm/min.

Signal Feedrate override coded check signal（G011#3~G011#7）

［Classification］ Input signal

［Function］ Cutting feedrate override signal divided into 5 binary coded signals which are corresponded to the override:

The override can be selected with 10% increment within 0~200%.

6.3 Override Cancel

General The override cancel signal fixes the feedrate override to 100%.

Signal Override cancel signal

OVC（G024＃1）

［Classification］ Input signal

［Function］ The feedrate override is fixed to 100%.

［Operation］ When the signal is 1, CNC operates as follows:

The feedrate override is fixed to 100% irrespective of the feedrate override signal.

Rapid traverse override and spindle speed override are not affected.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G024							OVC	

Chapter 7 Miscellaneous Function

7.1 M code Miscellaneous Function

General M code miscellaneous function When the system runs the registed M code, the registered signals (F026.0~F033.7) and strobe signals are sent to the PLC, the PLC using these signals starts or turns off their relevant functions.

Basic procedure

The following signals are used for the following functions.

Table 7-1-1

Function	Program address	Output signal		Repsonse signal	Completion signal
		login signal	Strobe signal		
M code miscellaneous function	M**	M**（F026#0~F033#7）	MF (F007 # 0）	MRESP (G063#0)	FIN(G000#0) MFIN(G000#1)

Suppose that MXXX is specified during a program:

If XXX is not specified, CNC alarms. When the user registers the M code in the system, the F signal is specified to be the only one, i.e. the code signal for F26~F33.

If a non-M, S, T, instructions such as move, dwell are specified with MST together, they are ran at the same time. When more than one code of the MST is specified in a same block, they will be executed by sequence.

Set the register signal FYYY.Y and strobe signal F007#0 to 1 in executing MXX, and ensure the reply signal RESP (G63#0) is set to 0 by PLC.

Upon completion of the operation, the PLC sets completion signal MFIN (G00#1) and FIN (G00#0) to 1. The completion signal is used by the miscellaneous function, spindle speed function, tool function. If any of these functions are executed simultaneously, the completion signal must be set to 1 upon completion of all the function.

Ensure that the PLC sets the reply signal MRESP (G63#0) to 0 upon completion of MXX.

The M, S, T instruction in a same block can be executed simultaneously, and CNC executes the next block when the completion signal FIN is confirmed to be 1

7.2 S Code Miscellaneous Function

General When the S code is to be executed, the I/O point or analog control is set by bit parameter No.1#2.

Basic procedure for spindle S code I/O point control:

Table 7-2-1

Function	Program address	Output signal		Repsonse	Completion signal
		F address signal	Strob signal		
S code miscellansous function	S*	S* （F22）	SF (F007＃2）	SRESP (G63#1)	FIN(G00#0) SFIN(G00#4)

The followings describe these S code functions:

（1） Suppose that SX is specified in a program:

X range is 1~8, alarm is issued if it is beyond this range, and S1~S8 correspond to F address signals F22#0~#7 respectively. (For S1, it corresponds to the F address signal F22#0.)

（2） If a non M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously.

（3） When S1 is executed, the F address signal F22#0 and the strobe signal F007#2 should be set to 1, and the response signal SRESP(G63#1) is set to 0 by the PLC.

（4） After the operation ends, the completion signal SFIN(G00#4) and FIN(G00#4) are set to 1. When M code miscellaneous function, S code miscellaneous function, T code miscellaneous function are executed simultaneously, after all functions must be compeleted, the completion signal FIN(G00#0) can be set to 1.

（5） When S1 is completed, the responde signal SRESP(G63#1) is set to 1 by the PLC.

（6） M, S, T codes in a same block will be executed simultaneously, and only the completion signal FIN is set to 1 could next block be executed.

Basic procedure for spindle S code analog control:

Table 7-2-2

Function	Program address	Output signal		Gear change completion signal	Response signal	Completion signal
		F address signal	Strob signal			
S code miscellansous function	S****	S** （F034#0~#2）	SF (F007＃2）	GRAR (G002#4）	SRESP (G063#1)	FIN(G000#0) SFIN(G000#4)

These S code functions are explained as the following:

（1） Suppose that SXXX is specified in a program: (F34#0~#2 is defined by data parameter P246~248, this signal can be used for gear exchange by PLC. S500 by 1000 set by data parameter P246.)

（2） If a non M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously.

（3） When S500 is to be executed, the F address signal F34#0 and the strobe signal F007#2 should be set to 1, and the response signal SRESP(G063#1) is set to 0 by PLC.

（4） After the gear change ends, the gear change completion signal GRAR (G002#4) is set to 1 by the PLC.

（5） After the operation ends, the completion signal SFIN(G000#4) and FIN(G000#4) are set to 1. When M code miscellaneous function, S code miscellaneous function, T code miscellaneous function are executed simultaneously, after all functions must be compeleted, the completion signal FIN(G000#0) can be set to 1.

（6） When S500 is completed, PLC completion signal SRESP(G063#1) is set to 1.

（7） M, S, T are simultaneously executed in the same block, after the completion signal FIN is set 1, the CNC can execute the next block.

7.3 T Code Miscellaneous Function

General T code Miscellaneous function T code with M code are used together. Such as T060M06;

When the T code is to be executed, the code signal (D241) and the strobe signal are sent to PLC, by these signals PLC switch on or off its functions.

Basic processing
The signals are used for the following functions:

Table 7-3-1

Function	Program address	Output signal		Repsonse signal	completion signal
		Data address	Strob signal		
T code miscellansous function	T**	T** （D241）	TF (F007＃3)	TRESP (G63#2)	FIN(G00#0) TFIN(G00#5)

（1） Suppose that TXX is specified in a program（XX is sent to code signal D241）:

（2） If a non M, S, T instruction such as move, dwell is specified in the same block with the miscellaneous function, these instructions will be executed simultaneously. If multiple MST codes are specified in the same block, these codes will be executed by sequence.

（3） If TXX is to be executed, the strobe signal F007#3 is set to 1.

（4） As the operation is finished, the completion signals TFIN (G000#5) and FIN (G000#0) are set to 1 by the PLC. If M, S, T codes are to be executed simultaneously, the completion signal FIN (G000#0) can't be set to1 till they are finished.

（5） M, S, T codes in the same block are executed simultaneously, and after the completion signal FIN is set to 1, the CNC can execute the next block.

Signal M code login signal

M00～M99（F026～F033）
M code miscellaneous function strobe signal
MF（F007＃0）
［Type］ Output signal
［Function］ These signals report PLC the specification of miscellaneous function.
［Output conditions］ For relative output conditions and procedure, please see "7.1 Miscellaneous function （M code）".

Note 1: The following miscellaneous functions are only processed in CNC: they are not output even Programmed:
M98，M99
M codes for calling subprograms
M codes for call customer macro programs
Note 2: The code signal and strobe signal as well as decoding signal can be output for the miscellaneous function listed below.
M00，M01，M02，M30
Note 3: M code is given by binary code by M00～M39.
For example: M5 corresponds to 00000101.

M **decoding signal**
DM00（F009＃7）

DM01（F009＃6）
DM02（F009＃5）
DM30（F009＃4）
［Type］ Output signal
［Function］These signals point out particular miscellaneous function actually specified. The correspondence list of program instruction miscellaneous functions to output signals is as following:

Table 7-3-2

Instruction	Output signal
M00	DM00
M01	DM01
M02	DM02
M30	DM30

［**Output conditions**］ M decoding signal is 1 while as:
The corresponding miscellaneous function is specified, and any move and dwell instructions specified in the same block are completed. These signals are not output when the **completion** signal of the miscellaneous function is returned before completion of such move instructions and dwell instructions.
M decoding signal is 0 while as:
FIN signal becomes 1.
Reset.

M code miscellaneous function end signal
MFIN（G000#1）
M code miscellaneous function response signal
MRESP（G063#0>）
［Classification］ input signal
［Function］ these signals informs M function has been specified.
［Output condition］about output conditions and execution process, refer to 7.1 M Code Miscellaneous Function.
S code miscellaneous function strobe signal
SF（F007＃2）
［Classification］ output signal
［Function］ these signals informs the actually specified spindle speed.
［Output condition］about output conditions and execution process, refer to 7.2 S Code Miscellaneous Function.
S code miscellaneous function end signal
SFIN（G000#4）
S code miscellaneous function response signal
SRESP（G063#1）
［Classification］ input signal
［Function］ these signals informs S code miscellaneous function has been specified.
［Output condition］about output conditions and execution process, refer to Section 7.2 S Code Miscellaneous Function.
Tool function strobe signal
TF（F007＃3）
［Classification］ output signal
［Function］ these signals informs the actual specified tool function.
［Output condition］about output conditions and execution process, refer to Section 7.3 T Code Miscellaneous Function.
Tool function end signal
TFIN（G000#5）

［Classification］ output signal
［Function］ these signals informs the actual specified tool function.
［Output condition］about output conditions and execution process, refer to Section 7.3 T Code Miscellaneous Function.

Miscellaneous function end signal
FIN（G000＃0）
［Classification］ input signal
［Function］ the signal indicates ends of M code miscellaneous function, S code miscellaneous function, T code miscellaneous function.
［Operation］ when the signal changes 1--0—1, the control unit's operation and execution process are referred to Section 7.1, Section 7.2, Section 7.3.

Warning
The above all functions share one end signal FIN（G000#0）, and the signal must be set to 1 after all functions end.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G000			TFIN	SFIN			MFIN	FIN
G063						TRESP	SRESP	MRESP
F007					TF	SF		MF
F009	DM00	DM01	DM02	DM30				

7.4 Miscellaneous Function Lock

General Inhibits execution of a specified M, S, and T function. That is, code signals and strobe signals are not issued. This function is used to check a program.

Signal Miscellaneous function lock signal
AFL（G021＃3）
［Classification］Input signal
［Function］ The signal selects the auxiliary function lock, i.e., the signal disables the execution of the specified M, S, T function.
［Operation］ When the signal becomes 1, the control unit functions are as follows:

1. For the automatic run, DNC run and MDI operation, the control unit does not execute M, S, and T functions. That is, the control unit stops the output of code signals and strobe signals.
2. If this signal becomes "1" after code signal output, the output operation is executed during the ordinary manner until its completion(that is, until the FIN signal is received, and the strobe signal becomes to "0".)
3. Among the miscellaneous function, M00,M01，M02 and M30 are executed even when this signal is "1". All code signals, strobe signals, decode signals are output during the ordinary manner.
4. Even when this signal is "1", M98 and M99 are executed during the control unit without outputting their execution results are executed during the ordinary manner.

Auxiliary function lock check signal
MAFL（F004＃4）
［Classification］ Output signal
［Function］ The signal reports the state of auxiliary function lock signal AFL.
［Output conditions］ When the signal is 1, the auxiliary function lock signal AFL is1.
When the signal is 0, the auxiliary function lock signal AFL is 0.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G021					AFL			
F004				MAFL				

Chapter 8 Spindle Speed Function

8.1 Spindle Speed Control Mode

General For GSK990MC system, the spindle is divided into gear spindle and analog spindle:

1. In gear spindle mode, CNC changes S code to switch value to output to the spindle to control the spindle speed.
2. During analog spindle, changes S code to analog value to output to the spindle to control the spindle speed.
   The control mode is I / O or analog is set by bit parameter NO:1#2.

8.1.1 Gear Spindle

General The gear spindle is defined that the spindle S code is controlled by I/O point.

Signal

Spindle speed strobe signal

SF（F007＃2）

Gear spindle address signal

F22#0～F22#7

［Classification］ Output signal

［Function］These signals report the actually specified the spindle speed function.

［Output conditions］For the output conditions and procedure, see “7.2 S code Miscellaneous Function, Spindle S Code I/O Control”.

Note：S code range: S1～S8, an alarm occurs when the system exceeds its range. The system’s ladder has only three gears S1, S2, S3 to provide for users, S4～S8 cannot be used, if necessary, corresponding ladder must be added.

8.1.2 Analog Spindle

General The analog spindle is defined that the spindle speed is controlled by the analog voltage value from the CNC. The CNC changes S code into the analog voltage value to output to the spindle of machine tool to control the spindle speed. The actual output analog voltage value equals to the S value controlled by the spindle multiplying the spindle override.

Signal **Spindle override coded signal（G019#0~G019#2）**

［Classification］Input signal

［Function］ Spindle override code detection signal has 3 binary system code signals which are corresponding with the override:

So, the spindle override can be selected based upon the 10% unit within the 50~120%.

When the spindle speed control is performed instead of using the spindle speed override, the setting override value is 100%.

Note: The spindle speed override function is invalid in thread cutting.

Gear change process:

Although S instructs the spindle speed, the actual is to control the spindle motor. So, the CNC needs to confirm the corresponding relation between the spindle motor and gear. Like S instruction selection，CNC selects the gear according to the previously defined gear speed range by parameter to report PLC to select the corresponding the gear by using the gear change select signal (GR3, GR2, GR1). At the same time, CNC outputs the spindle motor speed according to the selected gear. CNC outputs the instruction corresponded to the spindle (GR1, GR2, GR3 output) speed by specifying S0～

S99999 during MDI mode. 2 or 4 speed gear (GR1, GR2, GR3) is set by No.246～249 to simultaneously output to the gear select signal. When the gear select signal is changed, CNC simultaneously output SF signal.
Specification of gear change signal is as follows:

Table 8-1-2-1

	No. 2 gear	No. 3 gear	Remark
GR1	Low	Low	Low：low-speed gear
GR2	High	Medium	Medium: medium-speed gear
GR3		High	High：high-speed gear

·When the code voltage is 10V, the spindle speed is A (No.246) (min-1)
·When the code voltage is 10V. the spindle speed is B (No.247) (min-1) (medium-speed at No. 3 gear)
·When the code voltage is 10V, the spindle speed is C (No.248)（min-1）(No.3 gear).
S and spindle motor speed instruction the voltage （0～10V）and gear select signal, （GR1，GR2，GR3）is as the above table.

Signal: Gear selection signal
GR1,GR2,GR3 (F034#0～#2)
[Classification] Output signal
[Function] These signals report PLC the selected gear.
[Output conditions] For the definition of these signals, see Gear change Mode.
Gear change select signal (input)
GR1,GR2,GR3 (G002#0～#2)
[Classification] Input signal
[Function] These signals report CNC the current selected gear.
[Output conditions] For the definition of these signals, see Gear change Mode.
Gear change in-position signal
GEAR (G002#4)
[Classification] Input signal
[Function] These signals report CNC the current selected gear in-position.
[Output conditions] For the definition of these signals, see Gear change Mode.
Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G002				GEAR		GR3	GR2	GR1
G022			SPOV	OVC	SMOV			
F007						SF		
F034						GR3	GR2	GR1

8.2 Rigid tapping

General During a tapping cycle, synchronous control is applied to the tapping operation of a tapping axis and the operation of the spindle.
Namely, during rigid tapping (G74, G84), CNC needs to detect the rotation direction signal of spindle to confirm the cutting feed direction and machining process.

Procedure:
Spindle rotating→ Z tool infeed tapping→ transmit M05 to spindle→ wait for spindle to completely stop→ transmit CCW instruction→ starting point of Z tool retraction→

spindle stops rotating
So, to realize the rigid tapping, the corresponding ladder must be written to report the rotation direction of CNC external spindle.

Signal rigid tapping signal

RGTATP（G003＃1）
［Classification］ Output signal
［Function］ Report to PLC that CNC is during the rigid tapping mode.
［Output conditions］ RGTAP 1：the current CNC is during the rigid tapping mode.
0：the current CNC is not during the rigid tapping mode.

Signal address

	＃7	＃6	＃5	＃4	＃3	＃2	＃1	＃0
G003							RGTAP	

Chapter 9 Programming Code

9.1 Custom Macro Program

General Although subprograms are useful for repeating the same operation, the custom macro function also allows use of variables, arithmetic and logic operations, and conditional branches for easy development of general programs. A machining program can call a custom macro with a simple instruction, just like a subprogram.

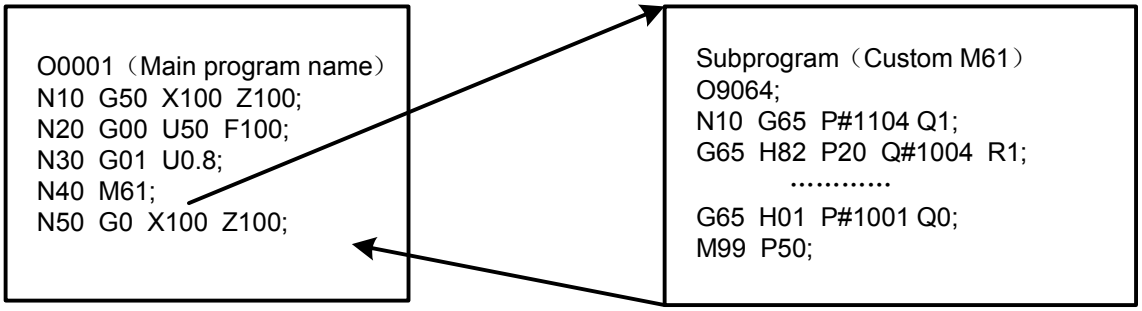


Fig. 9-1-1

This reports some function programmed by macro program can be taken as the general function. i.e., the program can be written by the data variable(variable data or unknown data. For example, the custom program can be used for technology.

Signal Custom macro program input signal

UI000~UI015（G054，G055）

［Classification］ Input signal

［Function］ The signals do not provide any functions for the control unit. These signals which are taken as one of system variable is read by macro program, used for the window signal between macro program and PLC.

The system variable corresponding to these signals are as follows:

Table 9-1-1

Signal	Address	Variable
UI000	G54#0	#1000
UI001	G54#1	#1001
UI002	G54#2	#1002
UI003	G54#3	#1003
UI004	G54#4	#1004
UI005	G54#5	#1005
UI006	G54#6	#1006
UI007	G54#7	#1007
UI008	G55#0	#1008
UI009	G55#1	#1009
UI010	G55#2	#1010
UI011	G55#3	#1011
UI012	G55#4	#1012
UI013	G55#5	#1013
UI014	G55#6	#1014
UI015	G55#7	#1015
UI000~UI015	G54，G55	#1032

Note: #1032 is variable with 16-digit as follows:

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
#1032	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000
#1032	UI015	UI014	UI013	UI012	UI011	UI010	UI009	UI008

Custom macro program output signal
UO000～UO015
（F054～F055）
［Classification］ Output signal
［Function］ The signals do not provide any functions for the control unit. These signals which are taken as one of system variable are read/written by macro program, used for the window signal between macro program and PLC.
The system variable corresponding to these signals are as follows:

Table 9-1-2

Signal	Address	Variable
UO000	F54#0	#1100
UO001	F54#1	#1101
UO002	F54#2	#1102
UO003	F54#3	#1103
UO004	F54#4	#1104
UO005	F54#5	#1105
UO006	F54#6	#1106
UO007	F54#7	#1107
UO008	F55#0	#1108
UO009	F55#1	#1109
UO010	F55#2	#1110
UO011	F55#3	#1111
UO012	F55#4	#1112
UO013	F55#5	#1113
UO014	F55#6	#1114
UO015	F55#7	#1115
UO000~UO015	F54,F55	#1132

Note: #1132 is a 16-digit variable.
Composition is as follows:

	#7	#6	#5	#4	#3	#2	#1	#0
#1132	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000
#1132	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008

9.2 Canned Cycle

General Canned cycles make it easier for the programmer to create programs. With a canned cycle, a frequently-used machining operation can be specified during a single block with a G code; without canned cycles, normally more than one block is required. During addition, the use of canned cycles can shorten the program to save memory.

One canned cycle consists of a sequence of six operations:

Operation 1: Positioning a hole

Operation 2: Rapid traverse up to R level

Operation 3: Hole machining

Operation 4: Operation at the bottom of a hole

Operation 5: Retraction to point R level

Operation 6: Rapid traverse up to the initial point

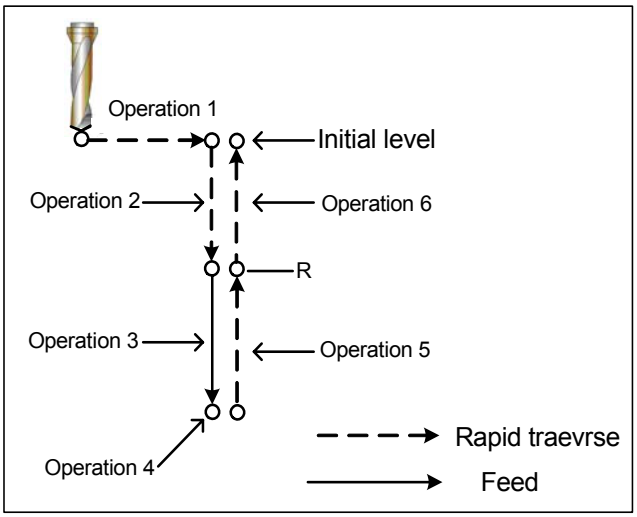


Fig. 9-2-1（fixed cycle's operation sequence）

The spindle control is required to output negative rotation spindle instruction in some canned cycle.

The following canned cycles require spindle control:

Reverse tapping cycle G74） Fine boring cycle G76）
Tapping cycle G84 Boring cycle G86
Back boring cycle G87 Boring cycle G88

For spindle control, the following normal miscellaneous functions are used:

See the description of the miscellaneous functions.

M03：CW spindle rotation

M04：CCW spindle rotation

M05：Spindle stops

M19：Spindle orientation

Tapping signal During the tapping cycle, output the tapping signal. When the tapping cycle G code is valid, CNC also outputs the tapping signal.

Override During the tapping, the cutting feedrate override is always set to 100%.

Feed hold During the tapping, the traverse does not stop immediately when the feed hold is pressed down. But it stops when the tool returns to R level.

Dry run TDR (parameter 12#5) defines if the dry run is valid during the tapping.

Signal **Tapping signal**

TAP(F001＃5)

[Classification**]** Output signal

[Function**]** The signal reports CNC is during tapping mode.

[Output conditions**]** The signal is 1:

－CNC is during the tapping cycle mode G74, G84.

－CNC is during the tapping cycle mode G63.

The signal is set to 0:

－CNC is not tapping cycle and tapping mode.

－The reset or emergency stop signal is input.

Signal address:

	#7	#6	#5	#4	#3	#2	#1	#0
F001			TAP					

Chapter 10 Display/Set

10.1 Clock Function

General Display the date time: year/month/date/hour/minute/second format on【CNC SET】.
（**Note: the clock is set only on the page.**）

10.2 Displaying Operation History

General The alarm page displays the current inside/outside user alarm messages of the system.
The alarm history page displays the current and previous alarm message of the system.
Operation record page display history operation records of the operator modifying the bit parameters and data parameters

10.3 Help Function

General The help function displays on the screen detailed report about alarms issued during the CNC and about CNC operations:
System message, system operation, G code, parameter talbe, macro command, PLC addresses.
The alarm list can display the system's all alarms and solutions.
The counter function helps the operator to count the data.

Chapter 11 Measurement

General Linear interpolation can be commanded by specifying axial following the G31 instruction, like G01. If an external skip signal is input during the execution of this instruction, execution of the instruction is halted and the next block is executed.

The skip function is used when the end of machining is not programmed but specified with a signal from the machine, for example, during grinding. It is used also for measuring the dimensions of a workpiece.

The coordinate values when the skip signal is turned on can be used during a custom macro because they are stored during the custom macro system variable #5016～#5019, as follows:

#5016 X-axis block' end point position

#5017 Y-axis block' end point position

#5018 Z-axis block' end point position

#5019 4TH-axis block' end point position

Signal Skip signal
SKIP （G001#1）

[Classification] Input signal

[Function] This signal terminates skip cutting. That is, the position where a skip signal turns to "1" during a block containing G31 is stored during a custom macro variable, and the move instruction of the block is terminated at the same time.

[Operation] When a skip signal turns to "1", the control unit works as described below.

When a block contains a skip cutting instruction G31, the control unit reads and stores the current position of the specified axis at that time. The control unit stops the axis, then cancels the remaining distance that the block was supposed to be moved.

The skip signal is monitored not for a rising edge, but for its state. So, if a skip signal continues to be "1", a skip condition is assumed to be satisfied immediately when the next skip cutting is specified.

Note: The skip signal width requires at least 10ms.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G001							SKIP	

Chapter 12 Panel Locked Setting

Signal Lock edit signal
LEDT（G016#6）
［Type］ Input signal
［Function］The signal locks the program edit function.
［Operation］When the signal is set to 1, the program edit function is valid but the program cannot be edited.
When the signal is set to 1, the program edit function is invalid.

Operation panel lock signal
LSYS（G016#7）
［Type］ Input signal
［Function］The signal locks the press key on the edit panel.
［Operation］When the signal is set to 1, all keys on the panel are locked and disenabled.
When the signal is set to 0, all keys on the panel are enabled.

Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G016	**LSYS**	**LEDT**						

Appendix 1 Addresses between PLC and CNC

1：**CNC**→PLC address：F000 ----- F064

Table-1

Signal name	Symbol	Address
Feed dwell signal	SPL	F000#4
Cycle start signal	STL	F000#5
Servo ready signal	SA	F000#6
Automatic operation signal	OP	F000#7
Alarm signal	AL	F001#0
Resetting signal	RST	F001#1
Spindle speed arrival signal	SAR	F001#3
Spindle enabling signal	ENB	F001#4
Tapping signal	TAP	F001#5
Rigid tapping executing signal	RTAP	F001#6
G63 tapping mode signal	MTAP	F001#7
Thread cutting signal	THRD	F002#3
Program start signal	SRNMV	F002#4
Cutting feed signal	CUT	F002#6
Dry run check signal	MDRN	F002#7
Incremental feed selection check signal	MINC	F003#0
MPG feed selection check signal	MH	F003#1
JOG feed check signal	MJ	F003#2
Manual data input check signal	MMDI	F003#3
DNC operation selection confirm signal	MRMT	F003#4
Automatic operation select check signal	MMEM	F003#5
Memory edit select check signal	MEDT	F003#6
Mechanical zero return select check signal	MZRO	F003#7
Skip optional block check signal	MBDT	F004#0
All-axis machine lock check signal	MMLK	F004#1
Single block check signal	MSBK	F004#3
Auxiliary function lock signal	MAFL	F004#4
Manual reference point return check	MREF	F004#5
Feedrate override OFF check signal	CFORD	F005#0
Spindle override OFF check signal	CSORD	F005#1
M code miscellaneous function strobe signal	MF	F007#0
S code miscellaneous function strobe signal	SF	F007#2
T code miscellaneous function strobe signal	TF	F007#3
External operation panel lock	LOPT	F008#0
Ignore hard limit	LALM	F008#1
Ignore emergency signal	EALM	F008#2
M30 decoded signal	DM30	F009#4
M02 decoded signal	DM02	F009#5
M01 decoded signal	DM01	F009#6
M00 decoded signal	DM00	F009#7
System model selection signal	CNCS	F010#0
Syntax checking signal	SCHK	F010#1
The system model selects 990MC when F010#0 and F010#2 are 1		F010#2
Electronic MPG drive state signal	RHPG	F010#7
Spindle speed arrival signal	SAR	F011#0
Spindle zero-speed check signal	ZSP	F011#1
Spindle orientation completion signal	COIN	F011#2
Speed/position switch completion signal	VPO	F011#3
Zero axis return completion signal	ZP1 --- ZP4	F016#0 --- #3
Axis move signal	MV1 --- MV4	F017#0 --- #3
System controlled axis quantity 1	AXIS1	F018#0
System controlled axis quantity 2	AXIS2	F018#1
System controlled axis quantity 4	AXIS4	F018#2

Signal name	Symbol	Address
System controlled axis quantity 8	AXIS8	F018#3
Axis move direction direction	MVD1 --- MVD4	F019#0 -- #3
The 4th axis indexing table releasing signal	BUCLP	F020#0
The 4th axis indexing table clamping signal	BCLP	F020#1
The 1st axis positive limit overtravel alarm	AL+1	F021#0
The 2nd axis positive limit overtravel alarm	AL+2	F021#1
The 3rd axis positive limit overtravel alarm	AL+3	F021#2
The 4th axis positive limit overtravel alarm	AL+4	F021#3
Spindle I/O gear control signal	SCODE1---SCODE8	F022#0---#7
The 1st axis negative limit overtravel alarm	AL-1	F023#0
The 2nd axis negative limit overtravel alarm	AL-2	F023#1
The 3rd axis negative limit overtravel alarm	AL-3	F023#2
The 4th axis negative limit overtravel alarm	AL-4	F023#3
M code miscellaneous function coded signal	M**	F026 --- F033（code addresses in M coded table, see Section 3.5, Ⅱ Operation
Spindle analog value controlling gear selection signal	GR1，GR2，GR3	F034#0 --- #2
Axis returning to the 1st reference point completion signal	ZP11—ZP14	F041#0 --- #3
Axis returning to the 2nd reference point completion signal	ZP21---ZP24	F042#0 --- #3
Axis returning to the 3rd reference point completion signal	ZP31---ZP34	F043#0 --- #3
Axis returning to the 4th reference point completion signal	ZP41---ZP44	F044#0 --- #3
The 3rd's 2nd reference point area check signal	AQ1	F045#0
The 3rd's 3rd reference point area check signal	AQ2	F045#1
The 3rd's 4th reference point area check signal	AQ3	F045#2
Custom macro program output signal	UO000 --- UO015 U100 --- U131	F054,F055 F056 --- F059
Reference point established signal	ZRF1 ---- ZRF4	F060#0 --- #3
Required part quantity arrival signal	ESEND	F061#1
Axis returning to reference point signal	ZRFJ1 ---- ZRFJ4	F061#2 --- #5

Appendix 2

Signal	**Symbol**	**Address**
Miscellaneous function end signal	FIN	G000#0
M code miscellaneous function end signal	MFIN	G000#1
S code miscellaneous function end signal	SFIN	G000#4
T code miscellaneous function end signal	TFIN	G000#5
Emergency stop signal	ESP	G001#0
Skip signal	SKIP	G001#1
Gear selection signal (input)	GR1,GR2, GR3	G002#0 --- #2
Gear change in-position signal	GEAR	G002#4
Rigid tapping signal	RGTAP	G003#1
Custom macro program interruption signal	UINT	G009#1
Axis mirror image signal	MT1---MT4	G010#0---#3
Rapid override coded signal	RV1--- RV2	G011#0 --- #1
Rapid override encoded signal 1，2，4，8，16	FV1，FV2，FV4，FV8，FV16	G011#3 --- #7
Aixs' positive/negative overtravel signal	+L1 --- +L4 -L1 ---- -L5	G012#0 ---- #3 G013#0 ---- #3
Edit lock signal	LEDT	G016#6
Operation panel lock signal	LSYS	G016#7
Zero deceleration signal check		G017#0 ---- #3
Additional axis selection	AXIS1，AXIS2， AXIS4，AXIS8	G018#0 ---- #3
Spindle override encode check signal	SV1，SV2，SV4，SV8	G019#0 ---- #3

Signal	Symbol	Address
Edit mode		G020#0
Auto mode		G020#1
MDI mode		G020#2
Zero return mode		G020#3
Step mode		G020#4
Manual mode		G020#5
MPG mode		G020#6
DNC mode		G020#7
Skip		G021#0
Single block		G021#1
Dry run		G021#2
Miscellaneous lock		G021#3
Machine lock		G021#4
Optional stop		G021#5
Program restart		G021#6
Spindle rotation CW		G022#0
Spindle stop		G022#1
Spindle rotation CCW		G022#2
Spindle override cancel		G022#4
Spindle JOG		G022#6
Channel selection signal		G022#7
Lubricating		G023#0
Cooling		G023#1
Chip removal		G023#2
Cycle start		G023#6
Feed hold		G023#7
Feedrate override cancel		G024#1
Rapid switch		G024#7
MPG/incremental feed movement amount selection signal	MP1, MP2	G026#4 ---- #5
Manual feed axis +1st		G027#0
Manual feed axis +2nd		G027#1
Manual feed axis +3rd		G027#2
Manual feed axis +Nth		G027#3
Manual feed axis -1st		G028#0
Manual feed axis -2nd		G028#1
Manual feed axis -3rd		G028#2
Manual feed axis -Nth		G028#3
Spindle orientation		G029#0
Overtravel release		G030#0
Spindle stop signal	*SSTP	G032#7
Spindle speed command output polar selection signal	SGN	G033#5
Spindle speed command polar selection signal	SSIN	G033#6
Indexing table releasing completion signal	BEUCL	G038#6
Indexing table clamping completion signal	BECLP	G038#7
Teaching function start signal	TEACH	G042#0
The 1st reference point check signal	PREF10----PREF13	G056#0 ----- #3
The 2nd reference point check signal	PREF20----PREF23	G057#0 ----- #3
The 3rd reference point check signal	PREF30----PREF33	G058#0 ----- #3
The 4th reference point checks signal	PREF40----PREF43	G059#0 ----- #3

Ⅳ Installation and Connection

Chapter 1 System Structure and Installation

1.1 System Composition

GSK990MC CNC system mainly consists of the following units as Fig. 1-1.

（1）GSK980TC3 CNC system
（2）Additional operator panel(optional)
（3）Digital AC Servo Drive Unit (or stepper drive unit)
（4）Servo motor (or stepper motor)
（5）AC transformer (isolation transformer)

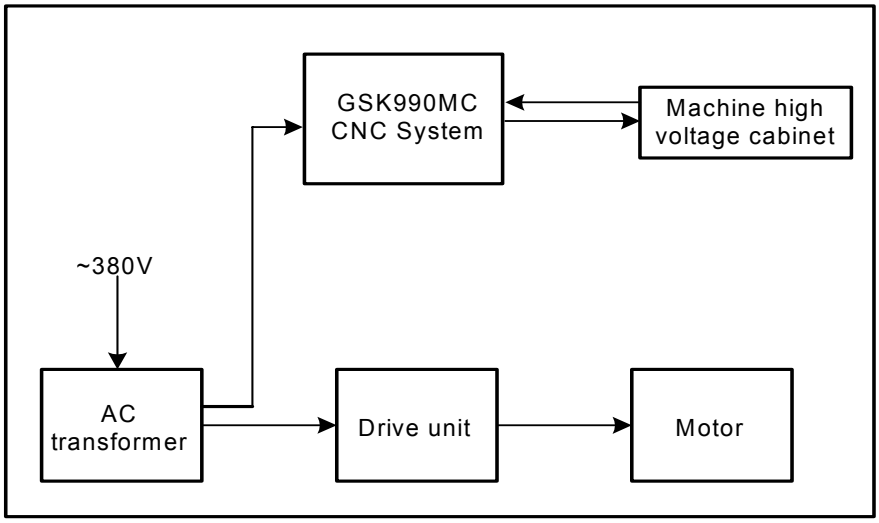


Fig. 1-1

1.2 System Installation & Connection

Firstly, check if the CNC system, driver, motor, and photoelectric encoder are ready, intact and matched.

The CNC system must be fixed stably, and there is some space around the system to ensure the air circulates, and the heat radiates. The installation position of CNC system must be convenient to the operation and avoid the position of processing chip and cooling.

The high/low voltage should be separated. The power supplies of CNC system and driver are provided by transformer, which are separated from the machine high voltage. All kind of signal line should be far from AC contactor to avoid the interference. The photoelectric encoder, limit signal and emergency stop signal should be directly connected to the CNC system. The power supply must be strictly grounded.

All kind of plug and bolt must be fixed stably, and forbid the signal connector is ON/OFF after the CNC system is turned on.

The system panel cannot be damaged by hard thing and sharp weapon when the CNC system is installed; the CNC system should be carried down to avoid dirtying the system panel.

There is no the source of high voltage, magnetic field around the CNC system, and the system should be far from the inflammable, explosive substance and all sort of dangerous things.

1.3 CNC System Installation Dimension

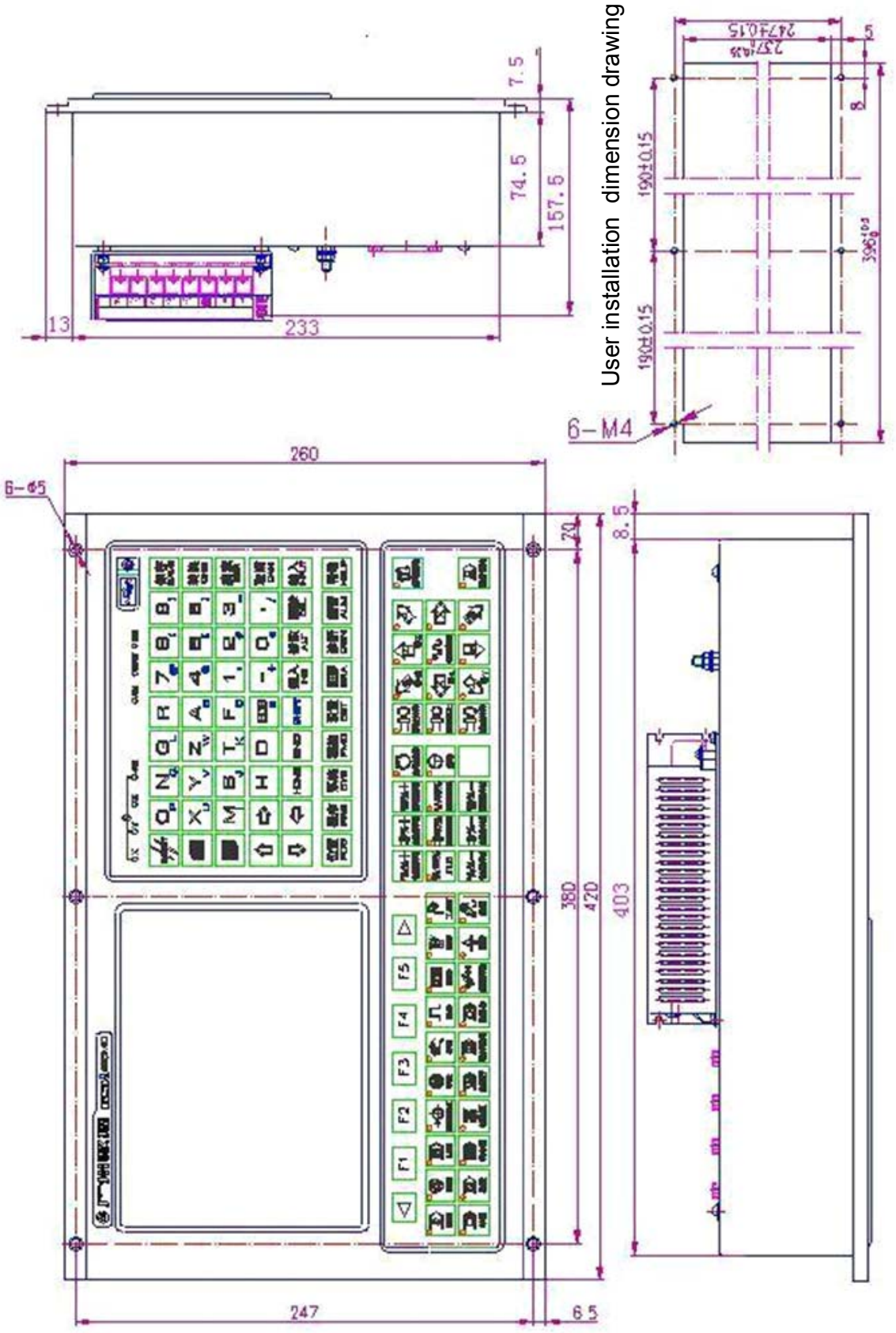


Fig.1-3-1 GSK990MC operation panel installation dimension drawing

1.4 Additional Panel

The user can select the additional panel for the system, and the functions of extension holes on the panel can be defined by the user, such as emergent stop, program lock, power on/off of the system, feed hold, cycle start, MPG and so on. The optional accessories of the system are as follows:
MPG: Changchun LGF-001-100；
Additional panel: aluminum alloy 420mm×71mm can be assembled under of GSK990MC operation panel;
Emergency stop button: LAY3-02ZS/1
Not self-locking button: KH-516-B11（green or red）;
Self-locking button: KH-516-B21（green or red）;

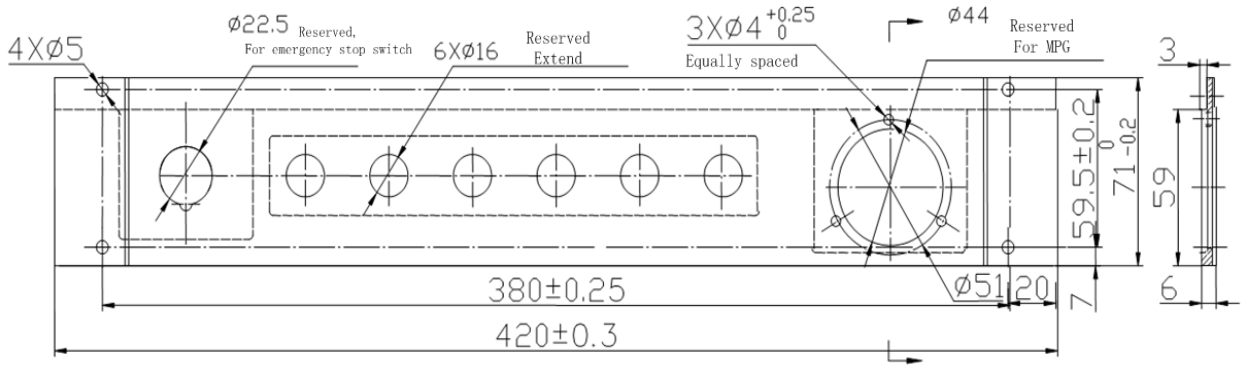


Fig. 1-4-1 GSK990MC additional panel

Chapter 2 Device Connection

2.1 CNC External Connection

2.1.1 Window Layout

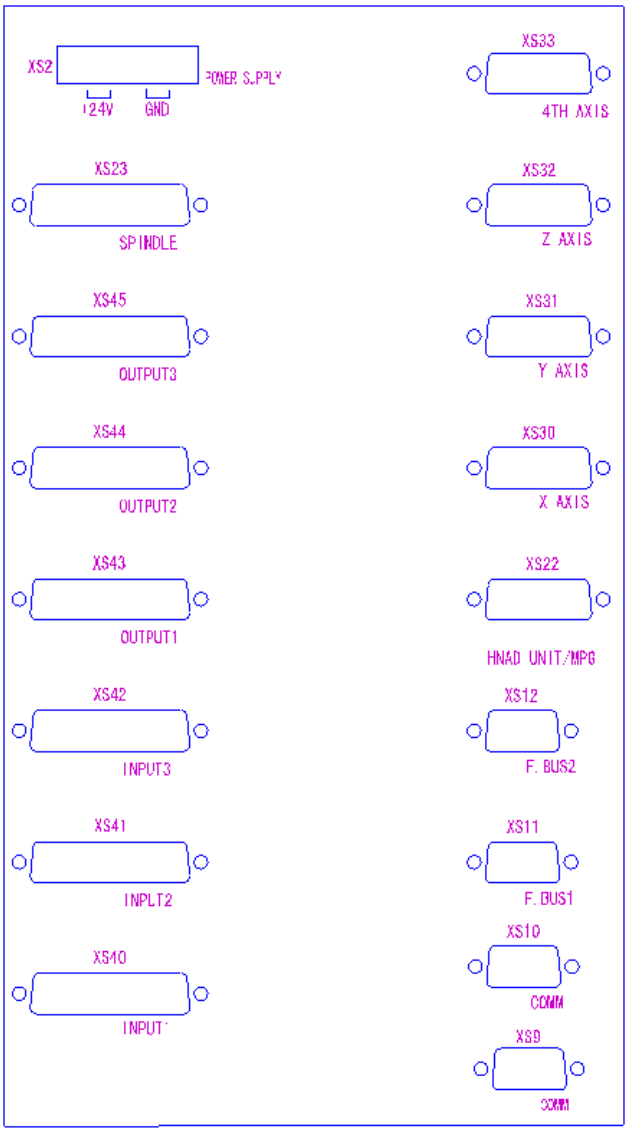


Fig. 2-1-1-1 GSK 990MC communication window

2.1.2 Pulse Servo Connection Diagram

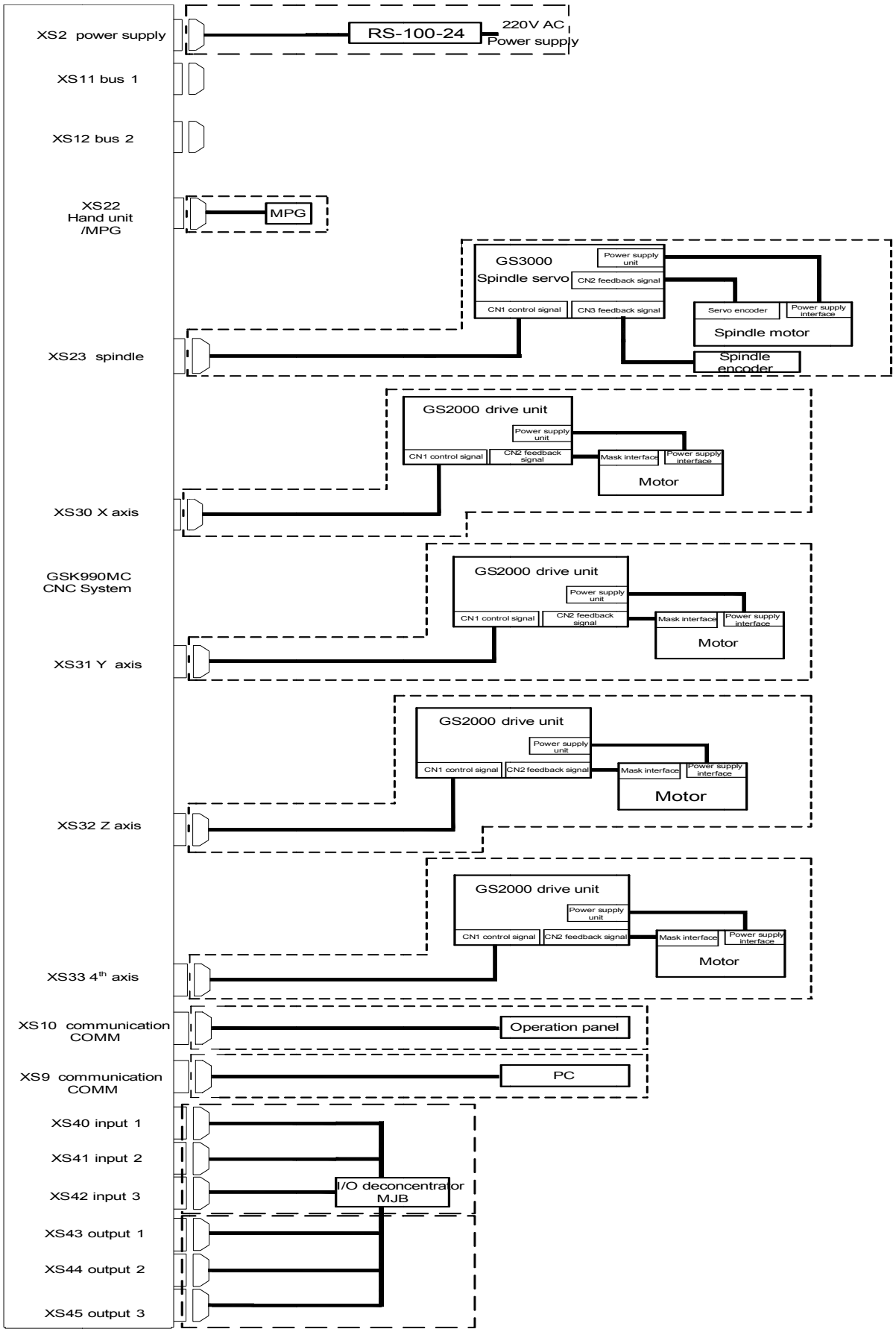


Fig. 2-1-2-1

2.1.3 Bus Servo Connection Diagram

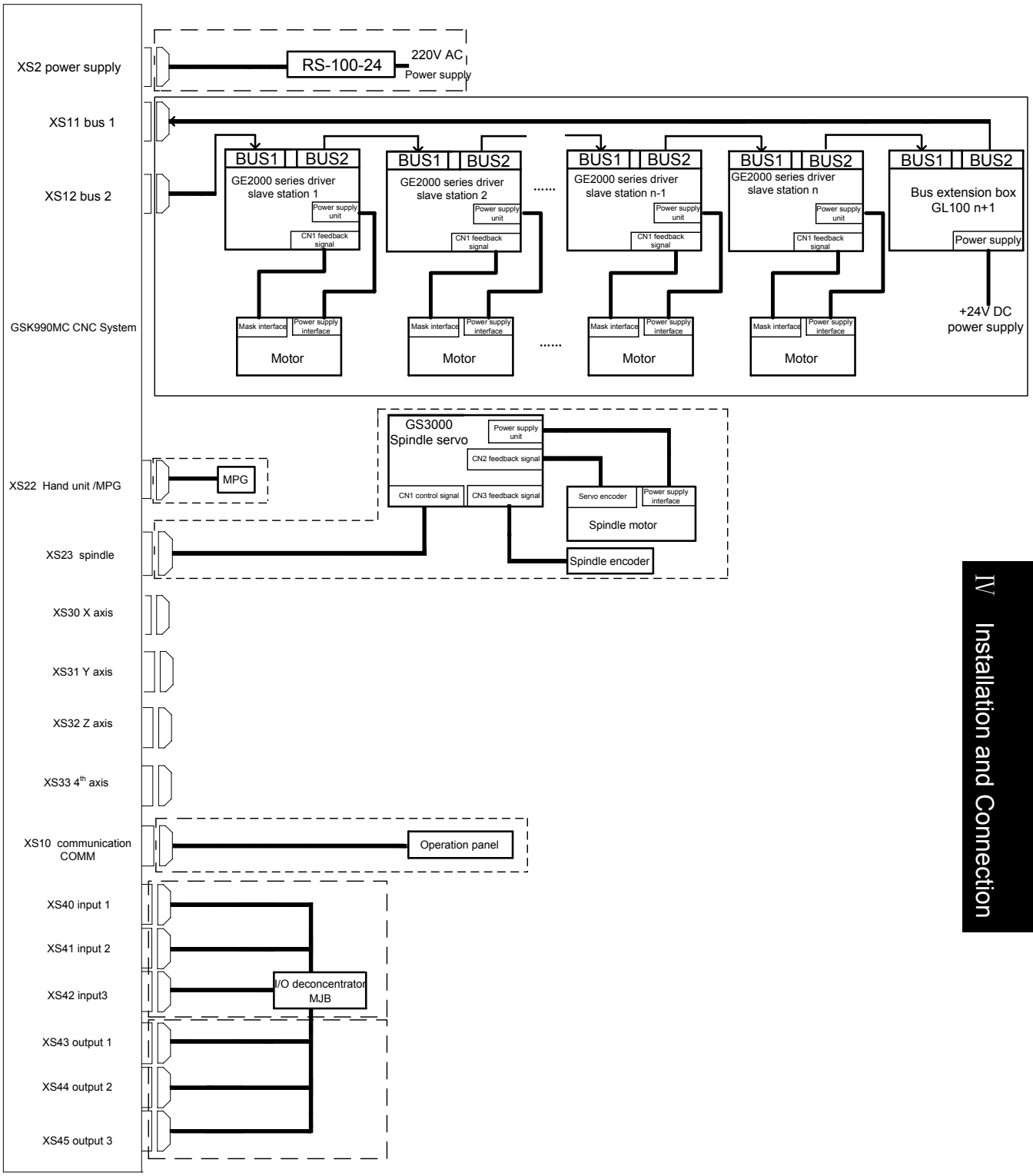


Fig. 2-1-3-1

2.2 Connection between the System and the Drive Unit

Interfaces connected with the drive unit include XS30（X axis）, XS31（Y axis）, XS32（Z axis）, XS33（the 4th axis）.

2.2.1 System Window Diagram

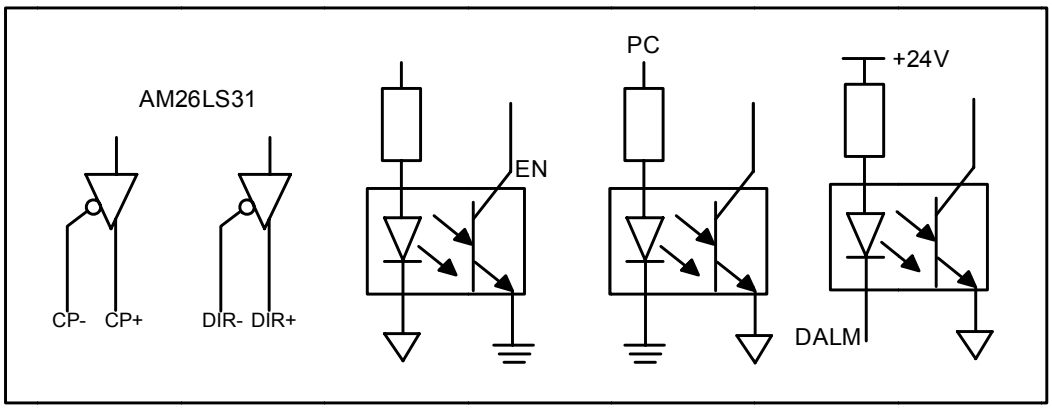


Fig.2-2-1-1

2.2.2 Window Signal Diagram

XS30：DB15 female（X）

1	XCP+	9	XCP-
2	XDIR+	10	XDIR-
3	XPC	11	0V
4	+24V	12	+5V
5	XDALM	13	+5V
6		14	0V
7	XEN	15	0V
8	0V		

XS31：DB15 female（Y）

1	YCP+	9	YCP-
2	YDIR+	10	YDIR-
3	YPC	11	0V
4	+24V	12	+5V
5	YDALM	13	+5V
6		14	0V
7	YEN	15	0V
8	0V		

XS32：DB15孔（Z axis）

1	ZCP+	9	ZCP-
2	ZDIR+	10	ZDIR-
3	ZPC	11	0V
4	+24V	12	+5V
5	ZDALM	13	+5V
6		14	0V
7	ZEN	15	0V
8	0V		

XS33：DB15孔（4TH axis）

1	4CP+	9	4CP-
2	4DIR+	10	4DIR-
3	4PC	11	0V
4	+24V	12	+5V
5	4DALM	13	+5V
6		14	0V
7	4EN	15	0V
8	0V		

Fig. 2-2-2-1

2.2.3 Signal Explanation

1. Pulse motion code signals

XCP+，XCP-，YCP+，YCP-，ZCP+，ZCP-，4CP+，4CP- are code pulse signals, XDIR+，XDIR-，YDIR+，YDIR-，ZDIR+，ZDIR-，4DIR+，4DIR- are movement direction signals. These signals use

difference output.
Their connection diagram is shown below:

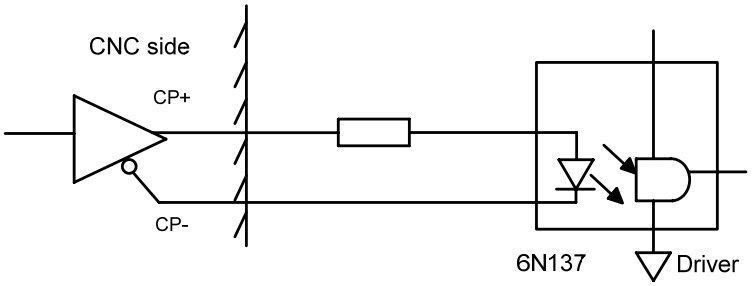


Fig. 2-2-3-1

2. The drive unit alarm signal ALM（input）
The signal's receiving mode at the side of the system is shown below. No.19 sets the drive unit alarm HIGH or LOW to be valid(HIGH or LOW is consistent with the drive unit's setting).

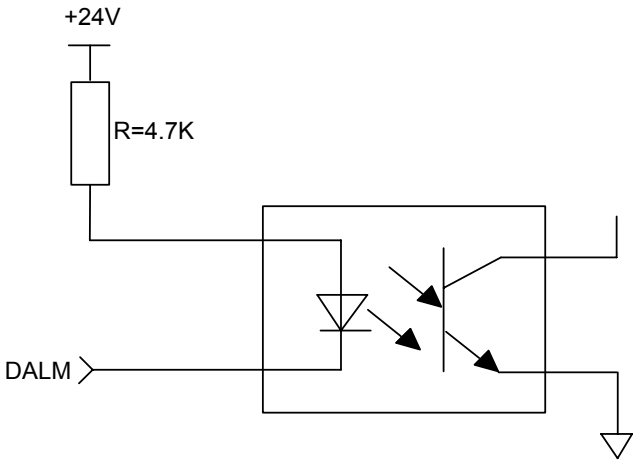


Fig. 2-2-3-2

3. The CNC system ready signal EN（contact output）

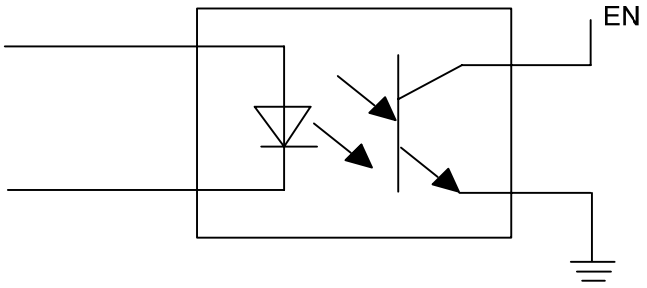


Fig. 2-2-3-3

4. Reference point return signal PC

The system supports +24V zero return and +5V zero return. The signal's receiving circuit at the side of the CNCsystem is shown below:

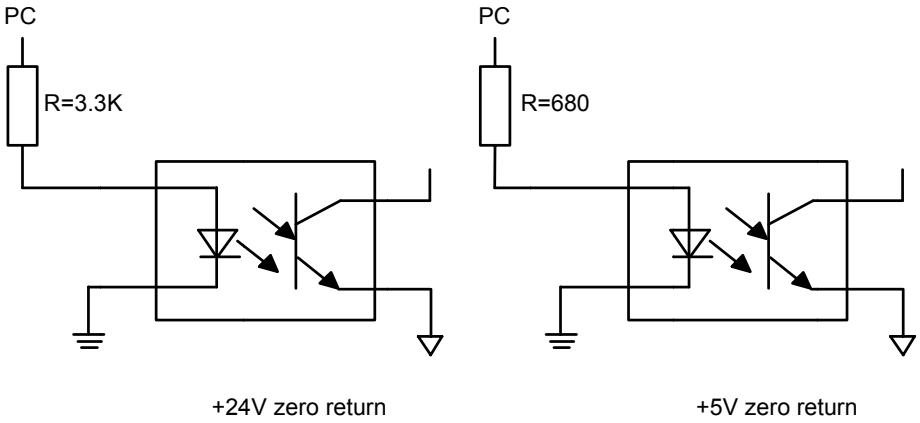


Fig. 2-2-3-4

PC signal's wave provided by the user is shown below:

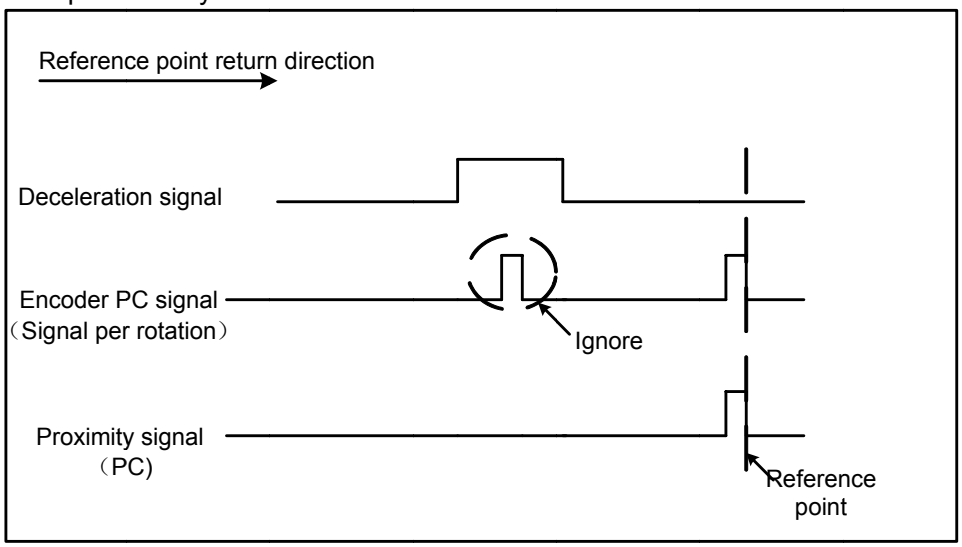
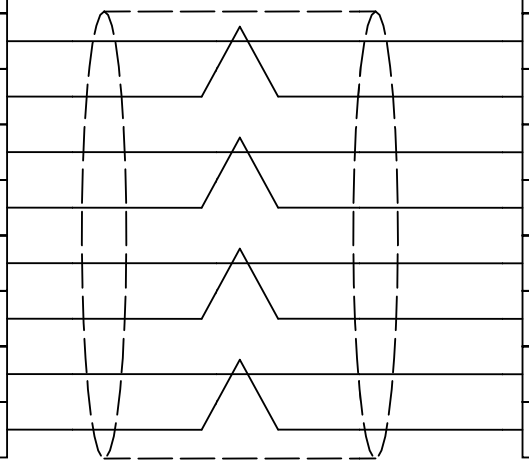


Fig. 2-2-3-5

2.2.4 Cable Connection Diagram

1. Cable drawing when GSK990MC connected with DY3 series drive units

XS30、31、32、33	
signal	Pin
nCP+	1
nCP-	9
nDIR+	2
nDIR-	10
nEN	7
＋5V	12
nDALM	5
0V	11



DY3 series driver	
signal	Pin
nCP+	1
nCP-	9
nDIR+	2
nDIR-	10
EN-	11
EN+	3
RDY1	6
RDY2	14

Fig. 2-2-4-1

2. Cable drawing when GSK990MC connected with DA98 series servo drive units

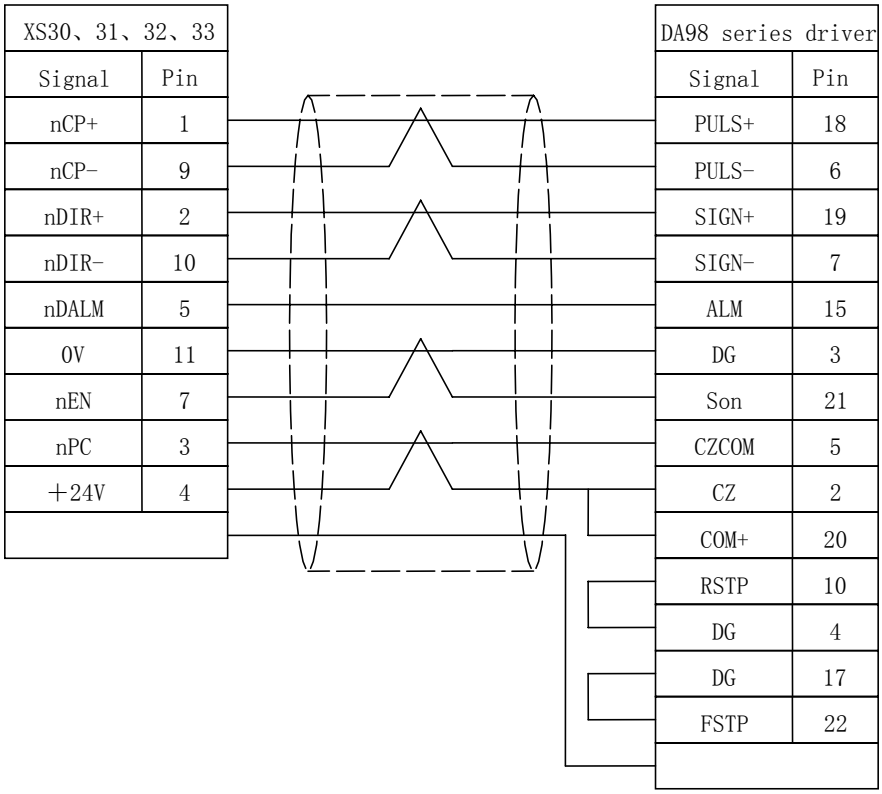


Fig. 2-2-4-2

3. Cable drawing when GSK990MC connected with DA98B series drive units

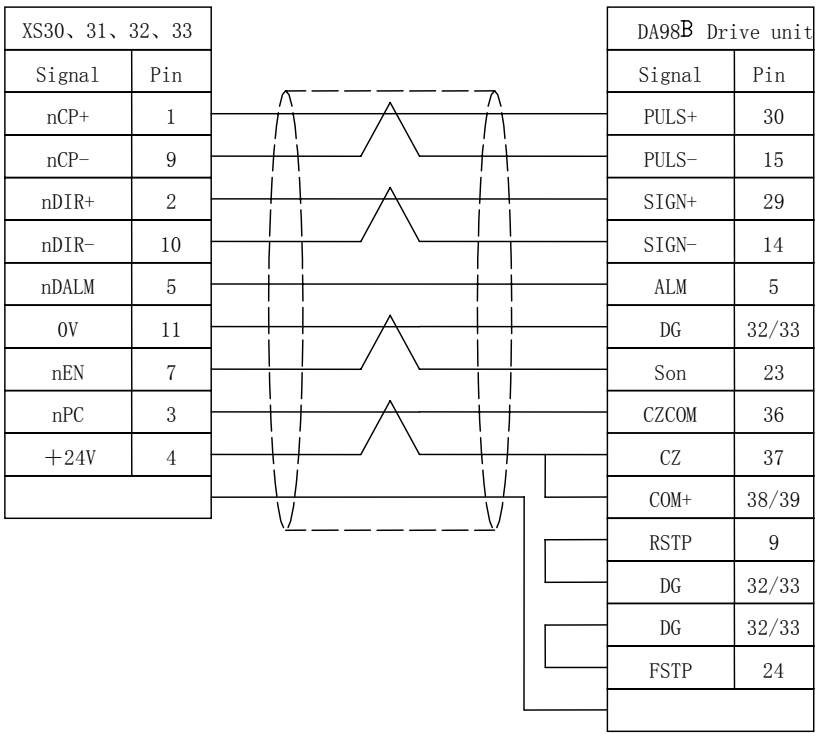


Fig. 2-2-4-3

4. Cable drawing when GSK990MC connected with GS2000 series servo drive units

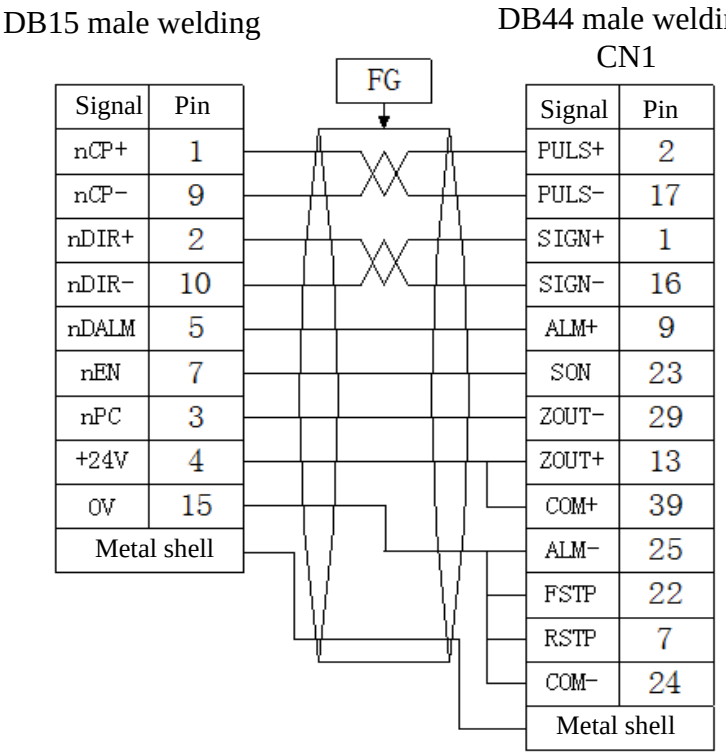


Fig. 2-2-4-4

2.2.5 GSK-LINK Cable Connection Drawing

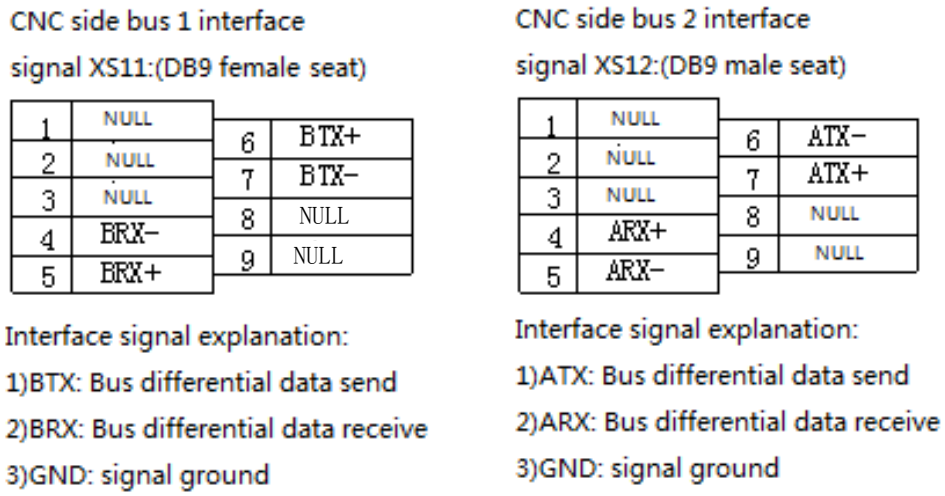


Fig. 2-2-5-1 CNC terminal bus window definition diagram

GT17 to DB9 female

GT17VS-8DS-HU(line ball) GE2000 series BUS1			Wired	DB9 female(welding wire) CNC XS12		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX (BI_DA-)	Orange-white		7	RX- (BI_DA-)	Green-white
2	RX+(BI_DA+)	Orange		6	RX+(BI_DA+)	Green
3	TX- (BI_DB-)	Green-white		4	TX- (BI_DB-)	Orange-white
4	TX+(BI_DB+)	Green		5	TX+(BI_DB+)	Orange
5	Reserved (BI_DC-)	Blue-white		8	Reserved (BI_DC-)	Brown-white
6	Reserved (BI_DC+)	Blue		9	Reserved (BI_DC+)	Brown
7	Reserved (BI_DD-)	Brown-white		1	Reserved (BI_DD-)	Blue-white
8	Reserved (BI_DD+)	Brown		2	Reserved (BI_DD+)	Blue

Fig. 2-2-5-2 CNC terminal's bus interface 2 connected with the drive unit

GT17 to DB9 male

GT17VS-8DS-HU(line ball) GE2000 series BUS2			Wired	DB9 male(welding line) CNC XS11		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX- (BI_DA-)	Orange-white		6	RX- (BI_DA-)	Green-white
2	RX+ (BI_DA+)	Orange		7	RX+ （BI_DA+)	Green
3	TX- (BI_DB-)	Green-white		5	TX- (BI_DB-)	Orange-white
4	TX+ (BI_DB+)	Green		4	TX+ (BI_DB+)	Orange
5	Reserved (BI_DC-)	Blue-white		8	Reserved (BI_DC-)	Brown-white
6	Reserved (BI_DC+)	Blue		9	Reserved (BI_DC+)	Brown
7	Reserved (BI_DD-)	Brown-white		1	Reserved (BI_DD-)	Blue-white
8	Reserved (BI_DD+)	Brown		2	Reserved (BI_DD+)	Blue

Fig. 2-2-5-3 Connection between CNC terminal bus window 1 and drive unit

GSK_LINK industry Ethernet network (GT17 interface)						
GT17VS-8DS-HU(line ball) GE2000 series BUS2			Wired	GT17VS-8DS-HU(line ball) GE2000 series BUS1		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX- (BI_DA-)	Orange-white		1	RX- （BI_DA-）	Green-white
2	RX+ （BI_DA+）	Orange		2	RX+ （BI_DA+）	Green
3	TX- （BI_DB-）	Green-white		3	TX- （BI_DB-）	Orange-white
4	TX+ （BI_DB+）	Green		4	TX+ （BI_DB+）	Orange
5	Reserved （BI_DC-）	Blue-white		5	Reserved （BI_DC-）	Brown-white
6	Reserved （BI_DC+）	Green		6	Reserved （BI_DC+）	Brown
7	Reserved （BI_DD-）	Brown-white		7	Reserved （BI_DD-）	Blue-white
8	Reserved （BI_DD+）	Brown		8	Reserved （BI_DD+）	Green

Fig. 2-2-5-4 connection among drive units

2.3 RS232(XS9) Standard Serial Window

GSK990MC CNC system can communicate with the general-purpose PC (must match with GSK990MC communication software) by RS232-C. Its connection is as follows:

Connection of cable is as follows. The shielded lien is connected with BDN, and the metal shell is not connected with the shielded line:

Fig.2-3-1

2.4 Connection between MPG and Handhold Unit

2.4.1 Window Signal Diagram

990MC system can be equipped with MPG or handhold unit in difference type or non-difference, the window signal is shown below:

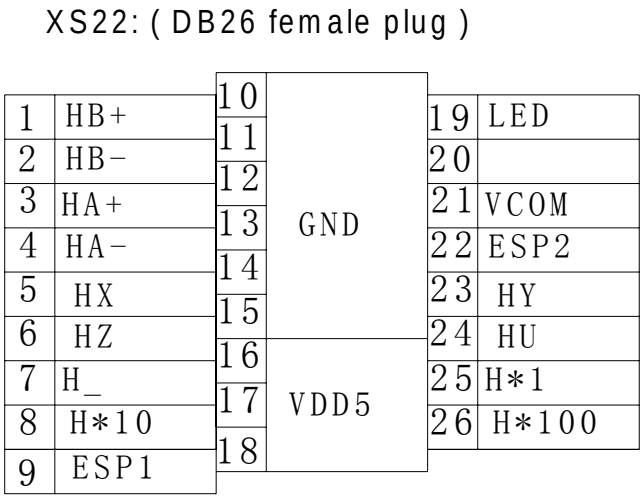


Fig. 2-4-1-1

2.4.2 Window Signal Explanation

HA+, HA-, HB+and HB-: with MPG in different type MPG (with non-difference type MPG: HA+, HB+ with +5V; HA- with MPG A; HB- with MPG B);
ESP1 and ESP2: Emergency stop signal of handhold unit;
HX, HY, HZ, HU, H4: They are respectively the axis selection signals of X, Y, Z, 4th
H*1, H*10, H*100: They are respectively the override signals of MPG pulse equivalent;
VCOM: Common port of handhold unit.
The connection diagram of 990MC with the internal MPG is shown as below:

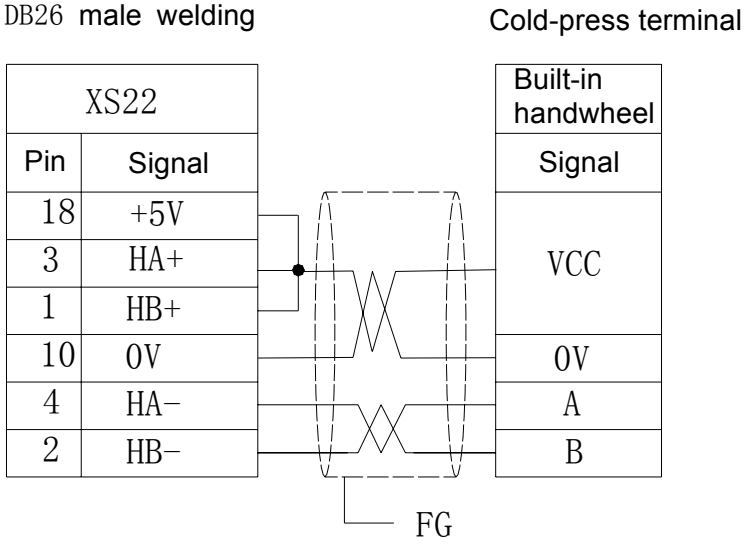


Fig.2-4-2-1

Connection diagram of GSK990MC with handhold unit in difference type（L）

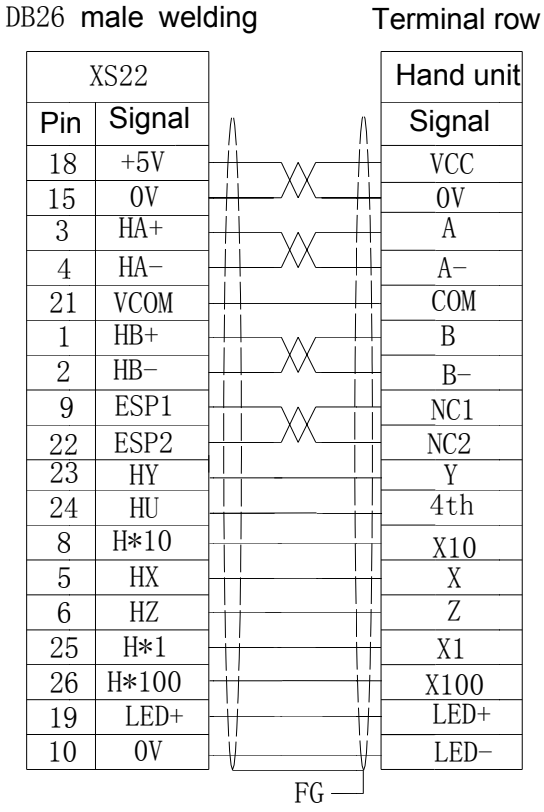


Fig. 2-4-2-2

Connection diagram of GSK990MC with handhold unit in voltage type（E）

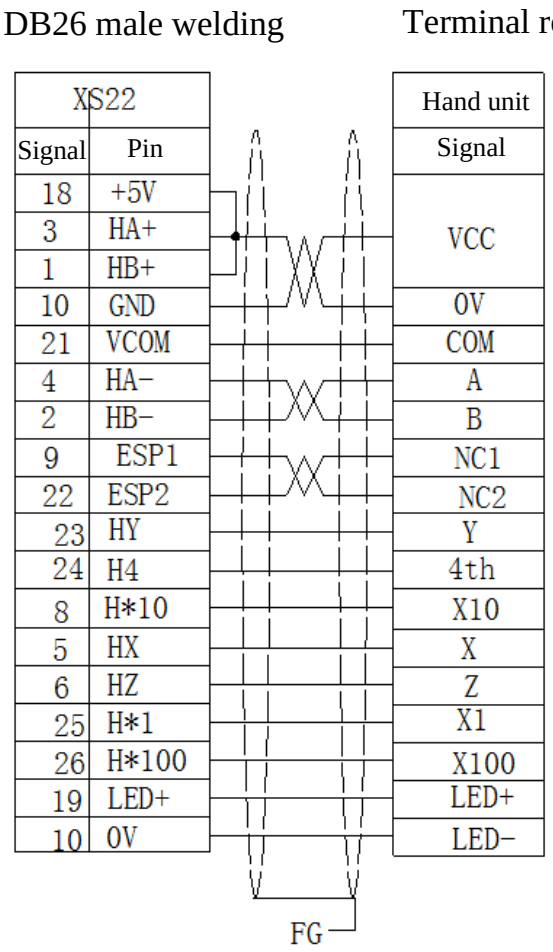


Fig.2-4-2-3

2.5 Connection of Spindle Unit

2.5.1 Window Signal Diagram

The system's interfaces are DB44 females, and their pin definitions are shown below:

XS23: (DB44 female plug)

1	PA-	16	PA+	31	GND
2	PB-	17	PB+	32	GND
3	PZ-	18	PZ+	33	SIGN+
4		19		34	SIGN-
5	SAR	20	ZSP	35	GND
6		21	COIN	36	GND
7	AxisALM	22		37	+24V
8		23	GND	38	+24V
9	SFR	24	SON	39	+24V
10	SP0	25	SRV	40	
11	STAO	26	+5V	41	
12	VP	27	ZSL	42	PULS+
13		28	PULS-	43	
14	VCMD+	29		44	VPO
15	GND	30			

Fig. 2-5-1-1

2.5.2 Interface Signal Explanation

1）VCMD+, VCMD- ：analog instruction input 0～10V or -10V～ +10V（determined by the parameter）;
2）Spindle output signal：SON spindle enabling, SFR spindle rotation(CW),SRV rotation (CCW), STAO spindle orientation, SP0 spindle selection, VP speed/position switch;
3）Spindle input signal: SAR spindle speed arrival, ZSP spindle zero-speed check, COIN spindle orientation completion, AxisALM alarm input, VPO speed/position switch completion;
4）PA+, PA-, PB+, PB-, PZ+, PZ-：spindle encoder's pulse signal;
5）PULS+, PULS-：positoin mode pulse instruction output;
6）SIGN+, SIGN-：position mode's direction instruction output.

2.5.3 Cable Connection Diagram

1. GSK990MC matched with control line's window wire of DAP03 spindle drive unit:

DB44 male welding

CNC side XS23	
Pin	Signal
15	GND
14	VCMD+
16	PA+
1	PA-
17	PB+
2	PB-
18	PZ+
3	PZ-
7	AxisALM
9	
25	
37	+24V
24	Spindle enable 6.2
11	Spindle orientation 6.3
27	Zero speed clamp Y6.5
12	Speed/pos switch Y6.4
42	PULS+
28	PULS-
33	SIGN+
34	SIGN-
5	S.speed arrival X7.2
20	S. zero speed check X7.3
21	S. orientation finish X7.1
44	Speed /pos switch finish X7.0
35	GND-

DB44 female welding

DAP03 spindle	
Signal	Pin
VCMD-	15
VCMD+	14
PA+	16
PA-	1
PB+	17
PB-	2
PZ+	18
PZ-	3
ALM	7
SFR	9
SRV	25
COM+	37
SON	24
STAO	11
ZSL	27
VP	12
PULS+	42
PULS-	28
SIGN+	33
SIGN-	34
SAR	5
ZSP	20
COIN	21
VPO	44
COM-	35

FG

Fig.2-5-3-1

2. GSK990MC matched with control line's window wire of GS3000 spindle drive unit:

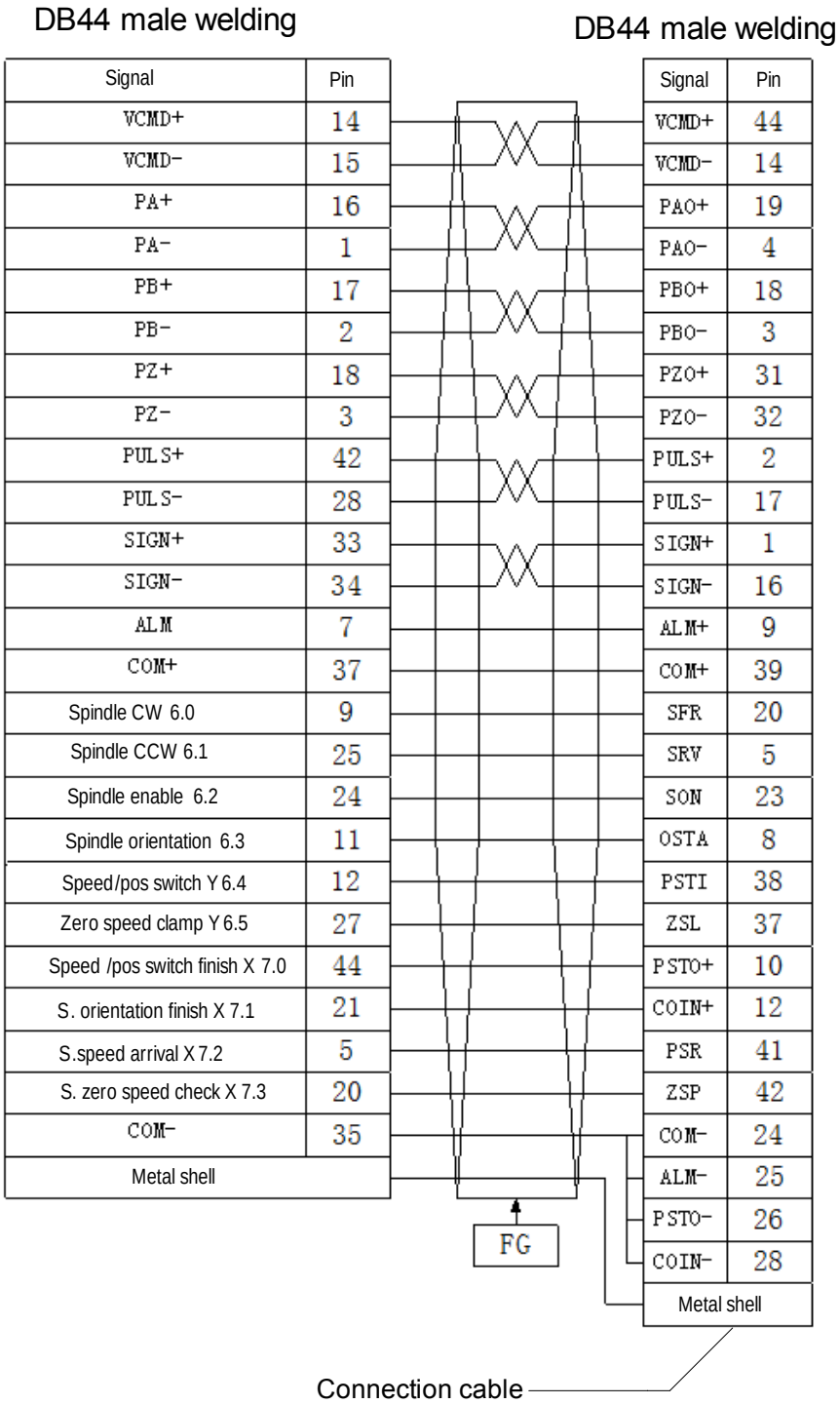


Fig. 2-5-3-2

2.5.4 GSK-Link Cable Diagram

CNC side bus 1 interface
Signal XS11: (DB9 female seat)

1	NULL	6	BTX−
2	NULL	7	BTX−
3	NULL	8	NULL
4	BRX−	9	NULL
5	BRX+		

Interface signal explanation:
1)BTX: Bus differential data send
2)BRX: Bus differential data receive
3)GND: signal ground

CNC side bus 2 interface
Signal XS12: (DB9 male seat)

1	NULL	6	ATX−
2	NULL	7	ATX−
3	NULL	8	NULL
4	ARX−	9	NULL
5	ARX+		

Interface signal explanation:
1)ATX: Bus differential data send
2)ARX: Bus differential data receive
3)GND: signal ground

Fig. 2-5-4-1 CNC terminal bus interface definition

GT17 to DB9 female						
GT17VS-8DS-HU(line ball) GE2000 series BUS1			Wired	DB9 female(welding line) CNC XS12		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX− (BI_DA−)	Orange-white		7	RX− (BI_DA−)	Green-white
2	RX+ (BI_DA+)	Orange		6	RX+ (BI_DA+)	Green
3	TX− (BI_DB−)	Green-white		4	TX− (BI_DB−)	Orange-white
4	TX+ (BI_DB+)	Green		5	TX+ (BI_DB+)	Orange
5	Reserved (BI_DC−)	Blue-white		8	Reserved (BI_DC−)	Brown-white
6	Reserved (BI_DC+)	Blue		9	Reserved (BI_DC+)	Brown
7	Reserved (BI_DD−)	Brown-white		1	Reserved (BI_DD−)	Blue-white
8	Reserved (BI_DD+)	Brown		2	Reserved (BI_DD+)	Blue

Note：1. Brackets in the signal name is 1000M network signal definition;
2. The industry Ethernet network type: IE-5CC4*2*AWG26/7-PVC (Weidmuller)

Fig. 2-5-4-2 CNC terminal's bus interface 2 connected with the drive unit

GT17 to DB9 male						
GT17VS-8DS-HU(line ball) GE2000 series BUS2			Wired	DB9 male(welding line) CNC XS11		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX− (BI_DA−)	Orange-white		6	RX− (BI_DA−)	Green-white
2	RX+ (BI_DA+)	Orange		7	RX+ (BI_DA+)	Green
3	TX− (BI_DB−)	Green-white		5	TX− (BI_DB−)	Orange-white
4	TX+ (BI_DB+)	Green		4	TX+ (BI_DB+)	Orange
5	Reserved (BI_DC−)	Blue-white		8	Reserved (BI_DC−)	Brown-white
6	Reserved (BI_DC+)	Blue		9	Reserved (BI_DC+)	Brown
7	Reserved (BI_DD−)	Brown-white		1	Reserved (BI_DD−)	Blue-white
8	Reserved (BI_DD+)	Brown		2	Reserved (BI_DD+)	Blue
Note：1. Brackets in the signal name is1000M network signal definition 2. The industry Ethernet network type: IE-5CC4*2*AWG26/7-PVC (Weidmuller)						

Fig. 2-5-4-3 CNC terminal's bus interface 1 connected with the drive unit

GSK_LINK industry Ethernet network(GT17 interface)						
GT17VS-8DS-HU(line ball) GE2000 series BUS2			Wired	GT17VS-8DS-HU(welding line) GE2000 series BUS1		
No.	Signal name	Cable color		No.	Signal name	Cable color
1	RX− (BI_DA−)	Orange-white		1	RX− (BI_DA−)	Green-white
2	RX+ (BI_DA+)	Orange		2	RX+ (BI_DA+)	Green
3	TX− (BI_DB−)	Green-white		3	TX− (BI_DB−)	Orange-white
4	TX+ (BI_DB+)	Green		4	TX+ (BI_DB+)	Orange
5	Reserved (BI_DC−)	Blue-white		5	Reserved (BI_DC−)	Brown-white
6	Reserved (BI_DC+)	Blue		6	Reserved (BI_DC+)	Brown
7	Reserved (BI_DD−)	Brown-white		7	Reserved (BI_DD−)	Blue-white
8	Reserved (BI_DD+)	Brown		8	Reserved (BI_DD+)	Blue
Note：1. Brackets in the signal name is 1000M network signal definition; 2. The industry Ethernet network type: IE-5CC4*2*AWG26/7-PVC (Weidmuller)						

Fig. 2-5-4-4 Connection among the drive units

2.6 System Power Supply Window

The system's input voltage is +24V. The power supply's window is shown below:

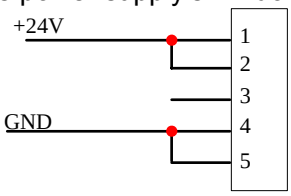


Fig.2-6-1

Chapter 3 Machine Control I/O Window

3.1 Interface Signal Table

XS40 (input1): DB25 male plug

1	IN00	14	IN01
2	IN02	15	IN03
3	COM	16	COM
4	+24V	17	IN04
5	IN05	18	IN06
6	IN07	19	COM
7	COM	20	+24V
8	IN08	21	IN09
9	IN10	22	IN11
10	COM	23	COM
11	+24V	24	IN12
12	IN13	25	IN14
13	IN15		

XS41 (input2): DB25 male plug

1	IN16	14	IN17
2	IN18	15	IN19
3	COM	16	COM
4	+24V	17	IN20
5	IN21	18	IN22
6	IN23	19	COM
7	COM	20	+24V
8	IN24	21	IN25
9	IN26	22	IN27
10	COM	23	COM
11	+24V	24	IN28
12	IN29	25	IN30
13	IN31		

XS43 (input3): DB25 male plug

1	IN32	14	IN33
2	IN34	15	IN35
3	COM	16	COM
4	+24V	17	IN36
5	IN37	18	IN38
6	IN39	19	COM
7	COM	20	+24V
8	IN40	21	IN41
9	IN42	22	IN43
10	COM	23	COM
11	+24V	24	IN44
12	IN45	25	IN46
13	IN47		

XS43 (output1): DB25 female plug

1	D000	14	D001
2	D002	15	D003
3	COM	16	+24V
4	+24V	17	D004
5	D005	18	D006
6	D007	19	COM
7	+24V	20	+24V
8	D008	21	D009
9	D010	22	D011
10	COM	23	+24V
11	+24V	24	D012
12	D013	25	D014
13	D015		

XS44 (output2): DB25 female plug

1	D016	14	D017
2	D018	15	D019
3	COM	16	+24V
4	+24V	17	D020
5	D021	18	D022
6	D023	19	COM
7	+24V	20	+24V
8	D024	21	D025
9	D026	22	D027
10	COM	23	+24V
11	+24V	24	D028
12	D029	25	D030
13	D031		

XS45 (output3): DB25 female plug

1	D032	14	D033
2	D034	15	D035
3	COM	16	+24V
4	+24V	17	D036
5	D037	18	D038
6	D039	19	COM
7	+24V	20	+24V
8	D040	21	D041
9	D042	22	D043
10	COM	23	+24V
11	+24V	24	D044
12	D045	25	D046
13	D047		

Fig. 3-1-1

XS40, XS41, XS42 are input interfaces（DB25 male），XS43, XS44, XS45 are output interfaces（DB25 female）.

3.2 Input Interface

3.2.1 Input Interface Circuit

DC input signals from machine to CNC come from the buttons of the machine side, the limit switch and the contacts of the relay, etc.

a）The contacts of the machine side should satisfy the following conditions:

Contact capacity: DC30V, above 16mA.

The leakage current of contacts during the open-circuit: below 1mA (voltage 26.4V).

The voltage drop of contacts during the closed-circuit: below 2V (current 8.5mA, including the voltage drop of the cable).

b) The return circuit of the signals is shown as Fig.**3-2-1-1**:

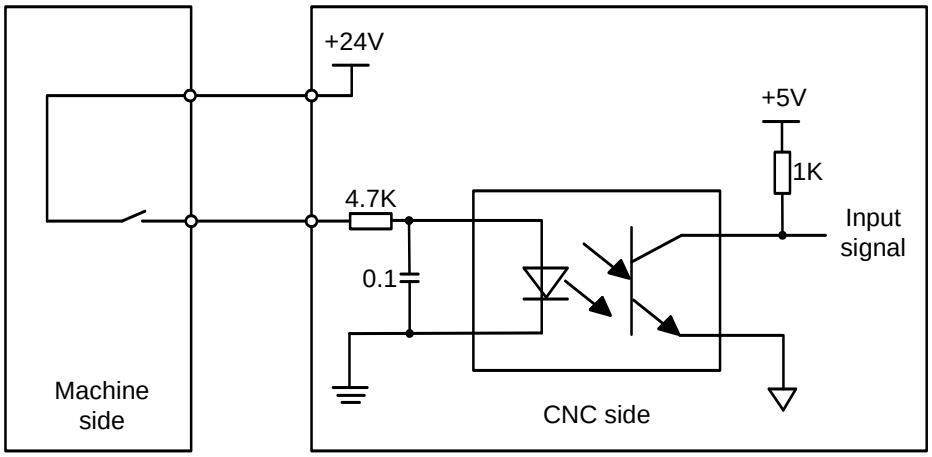


Fig.3-2-1-1

3.2.2 Handhold Unit's Interface Circuit

a）Handhold unit only receives 0V level input, prohibits 24V input.

b）Axis and override signal circuits are shown in Fig. 3-2-2-1

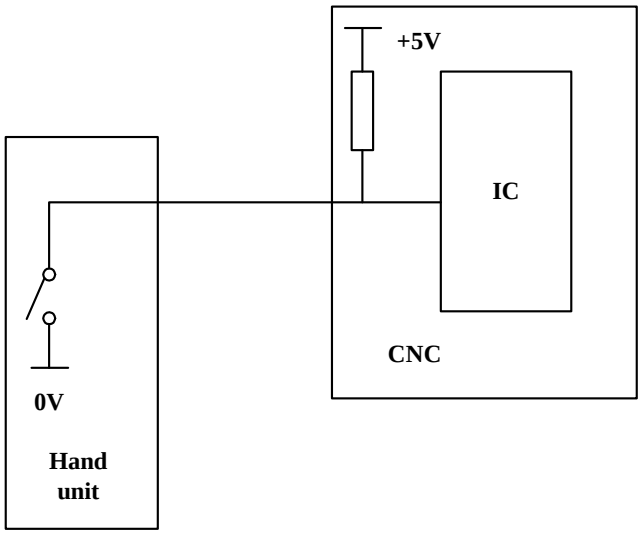


Fig. 3-2-2-1

3.2.3 Interface Definition of the Input Signals

Definitions of each pin of the input interfaces are show in the following table:

Table 3-2-3-1

Address	Signal interface	Interface pin	Definition	Contact selection
X000.0	XS40	1	The 1st axis positive travel limit signal	Normally-closed contact
X000.1	XS40	14	The 1st axis negative travel limit signal	Normally-closed contact
X000.2	XS40	2	The 2nd axis positive travel limit signal	Normally-closed contact
X000.3	XS40	15	The 2nd axis negative travel limit signal	Normally-closed contact
X000.4	XS40	17	The 3rd axis positive travel limit signal	Normally-closed contact
X000.5	XS40	5	The 3rd axis negative travel limit signal	Normally-closed contact
X000.6	XS40	18	The 4th axis positive travel limit signal	Normally-closed contact
X000.7	XS40	6	The 4th axis negative travel limit signal	Normally-closed contact
X001.0	XS40	8	The 1st zero speed deceleration signal	Normally-closed contact
X001.1	XS40	21	The 2nd zero speed deceleration signal	Normally-closed contact
X001.2	XS40	9	The 3rd zero speed deceleration signal	Normally-closed contact
X001.3	XS40	22	The 4th zero speed deceleration signal	Normally-closed contact
X001.4	XS40	24	Emergency stop switch（990MC integrated）	Normally-closed contact

Address	Signal interface	Interface pin	Definition	Contact selection
X001.5	XS40	12	External cycle start	Normally open contact
X001.6	XS40	25	External feed hold	Normally open contact
X001.7	XS40	13	Lubricating pressure or oil level check	Normally open contact
X002.0	XS41	1	Air source pressure check	Normally open contact
X002.1	XS41	14	Skip signal	Normally open contact
X002.2	XS41	2	Indexing table releasing check	Normally open contact
X002.3	XS41	15	Indexing table clamping check	Normally open contact
X002.4	XS41	17	External clamping/releasing tool control	Normally open contact
X002.5	XS41	5	Releasing tool check	Normally open contact
X002.6	XS41	18	Clamping tool check	Normally open contact
X003.0	XS41	8	Edit lock	Normally open contact
X003.1	XS41	21	Operation lock	Normally open contact
X003.5	XS41	12	Undefined	
X003.6	XS41	25	Undefined	
X003.7	XS41	13	Undefined	
X004.0	XS42	1	Chip removal motor overload check signal	Specified by the parameter
X004.1	XS42	14	The spindle gear 1 in-position	Normally open contact
X004.2	XS42	2	The spindle gear 2 in-position	Normally open contact
X004.3	XS42	15	The spindle gear 3 in-position	Normally open contact
X004.4	XS42	17	Undefined	
X004.5	XS42	5	Safety door check switch	Normally open contact
X004.6	XS42	18	Undefined	
X004.7	XS42	6	Undefined	
X007.0	XS23	44	Speed/position switch completion	Specified by the parameter
X007.1	XS23	21	Spindle orientation completion	Specified by the parameter
X007.2	XS23	5	Spindle speed arrival	Specified by the parameter
X007.3	XS23	20	Spindle zero speed check	Normally-closed contact

Definitions of each pin of handhold unit's interface are shown below:

Table 3-2-3-2

Address	Signal interface	Interface pin	Definition	Contact selection
X006.0	XS22	5	External MPG's 1st axis' axis selection	Normally open contact
X006.1	XS22	23	External MPG's 2nd axis' axis selection	Normally open contact
X006.2	XS22	6	External MPG's 3rd axis' axis selection	Normally open contact
X006.3	XS22	24	External MPG's 4th axis' axis selection	Normally open contact
X006.4	XS22	25	External MPG's step 0．001	Normally open contact
X006.5	XS22	8	External MPG's step 0．01	Normally open contact
X006.6	XS22	26	External MPG's step 0．1	Normally open contact
X006.7	XS22	ESP（9，22）	External emergency stop	Normally-closed contact

3.3 Interface Output

3.3.1 Circuit of Output Interface

a）The specification of the transistor for output:

① When the output is ON, the maximum load current includes the instant current below 200mA.

② When the output is ON, the maximum satuation voltage is 1.6V during 200mA, and its typical value is 1V.

③ When the output is OFF, the voltage resistance includes the instant voltage below 24+20%.

④ When the output is OFF, the leakage current is below 100μA.

b）The output return circuit:

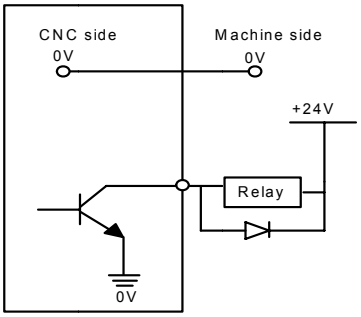


Fig. 3-3-1-1

All the output signals of the system are provided by Darlington tube, and when the output is valid, the corresponding Darlington tube is conducted.

3.3.2 Definitions of the Output Signal Interfaces

Table 3-3-2-1

Address	Signal interface	Interface pin	Definition
Y000.0	XS43	1	Z axis brake
Y000.1	XS43	14	Cooling
Y000.2	XS43	2	The tool releasing/ clamping
Y000.3	XS43	15	Skip signal selection switch
Y000.4	XS43	17	The spindle brake
Y000.5	XS43	5	Workpiece measure probe start
Y000.6	XS43	18	The red alarm lamp
Y000.7	XS43	6	The yellow alarm lamp
Y001.0	XS43	8	The green alarm lamp
Y001.1	XS43	21	Chip removal control
Y001.2	XS43	9	Lubricating control
Y001.3	XS43	22	The machine lighting control
Y001.4	XS43	24	Hydraulic pressure starting
Y001.5	XS43	12	Blowing the spindle
Y001.6	XS43	25	The indexing table releasing
Y001.7	XS43	13	The indexing table clamping
Y002.0	XS44	1	Toolsetting blowing air function
Y002.1	XS44	14	Chip removal rotation CCW
Y002.2	XS44	2	Undefined
Y002.3	XS44	15	Undefined
Y002.4	XS44	17	Undefined
Y002.6	XS44	18	Hydrovalve output
Y002.7	XS44	6	Undefined
Y003.4	XS44	24	The spindle gear 1(frequency conversion/IO point control)
Y003.5	XS44	12	The spindle gear 2(frequency conversion/IO point control)
Y003.6	XS44	25	The spindle gear 3(frequency conversion/IO point control)
Y003.7	XS44	13	Undefined
Y004.0	XS45	1	Undefined
Y004.1	XS45	14	Undefined
Y004.2	XS45	2	Undefined
Y004.3	XS45	15	Undefined
Y004.4	XS45	17	Undefined
Y004.5	XS45	5	Undefined
Y004.6	XS45	18	Undefined
Y004.7	XS45	6	Undefined
Y005.0	XS45	8	Undefined
Y005.1	XS45	21	Undefined
Y005.2	XS45	9	Undefined
Y005.3	XS45	22	Undefined
Y005.4	XS45	24	Undefined
Y005.5	XS45	12	Undefined

Address	Signal interface	Interface pin	Definition
Y005.6	XS45	25	Undefined
Y005.7	XS45	13	Undefined
Y006.0	XS23	9	The spindle CW rotation
Y006.1	XS23	25	The spindle CCW rotation
Y006.2	XS23	24	The spindle enable
Y006.3	XS23	11	The spindle orientation
Y006.4	XS23	12	Switching between speed/position mode
Y006.5	XS23	27	Clamping at zero speed

Chapter 4 Machine Debugging

The chapter introduces the trial operation methods and steps after GSK990MC system is turned on firstly, and the corresponding machine operation can be performed after the following steps are done.

4.1 Debug Preparation

Debugging GSK990MC can be operated based on the following steps:
Connection of the system: The correct connection is the base of the system debugging.
PLC debugging: Make the system safety function (such as the emergency stop and hardware limit, etc) and the operation function effective.
Setting the drive unit parameters: Set the parameters of the motor type and the control mode, etc.
Setting the system parameters: Set the control and the speed parameters, etc.
Data backup: After the system debugging, the data, such as the parameter, compensation data and PLC program, should be backup.
Pay attention to the following matters before debugging and running GSK990MC:
Check the fly-wheel diobe polar of the relay and the solenoid valve to guarantee all the cables connected correctly.
Check the connection phase sequence of strong current cables of the motor.
Check the corresponding relations between the position control cable, the coded wheel feedback cable and the motor strong current cable of AC servo feed unit.
Confirm the type of the analog voltage code received by the spindle.
Confirm all the earth wires are connected properly.
Confirm the usefulness of the emergency stop button and the emergency stop return circuit. Make sure that the power supply of the drive device and that of the spindle drive device are OFF after pressing the emergency stop button or disconnecting the emergency return circuit.
Confirm the voltage of each circuit power supply is correct and the polar is connected right.
Confirm the power supply specification in each circuit is correct.
Confirm each transformer specification and in-out direction in the circuit is correct.
Confirm the power supply in-out circuit direction of each breaker is correct.

4.2 System Power-on

Press the emergency stop button and make sure all the air switches are OFF.
Switch on the air switch of the main power supply in the cabinet.
Connect the air switch controlling DC24V or the fuse and check whether DC24V power supply is normal or not.
Check whether the power supply of the other parts is normal or not.
Electrify GSK990MC CNC device.

4.3 Emergency Stop and Limit

The system is with the software limit function. For safety, the hardware limit measure should be adopted meanwhile, and the limit switches of each axis in positive and negative directions should be installed.

The user can monitor and check the state of the emergency stop input signal through checking NO：1#4（*ESP）on【X signal】software window of the <diagnosis> window. After pressing the emergency stop button, all the air switches of the system must be OFF.

In JOG or MPG mode, each coordinate axis is moved slowly to testify the validity of each axis overrun limit switch, the overrun release button and the correctness of alarm display. The system alarms when the overrun occurs or the emergency stop button is pressed; while press the overrun release button and the axis moves oppositely, the system can release the alarm.

The emergency stop signal

Parameter diagnosis (The input state on the system side)

Sate address				**X1.4**				
Pin NO.				**XS40.24**				

Note: the system prompts: 0251：emergency stop alarm，980TC3 system checks X9.4.

It's required to correctly display the alarm "some axis (the 1st axis or the 2nd or the 3rd axis) in some direction (positive or negative) when the servo axis overruns. And it guarantees that after the overrun is released, the axis can't move in the overtravel direction when some axis overruns and the alarm occurs. Therefore, GSK990MC system provides two connection methods of overrun limit switches to satisfy the customers' requirements.

A. The situations of two limit switches:

(One limit switch of some axis in the positive direction, the other is in the negative)

1. Please strictly connect as the following list:

Table 4-3-1

Address	Signal window	Window pin	Definition	Contact
X000.0	XS40	1	Limit signal of the 1st axis positive stroke	Normally closed contact
X000.1	XS40	14	Limit signal of the 1st axis negative stroke	Normally closed contact
X000.2	XS40	2	Limit signal of the 2nd axis positive stroke	Normally closed contact
X000.3	XS40	15	Limit signal of the 2nd axis negative stroke	Normally closed contact
X000.4	XS40	17	Limit signal of the 3rd axis positive stroke	Normally closed contact
X000.5	XS40	5	Limit signal of the 3rd axis negative stroke	Normally closed contact
X000.6	XS40	18	Limit signal of the 4th axis positive stroke	Normally closed contact
X000.7	XS40	6	Limit signal of the 4th axis negative stroke	Normally closed contact

2. Rewriting the following parameters:：

Table 4-3-2

Address	Definition	State 0	State 1	Setting value
K006.0	Whether to use 1 limit switch or not	2 PCS	1 PC	0

B. With one stroke limit switch：

(With one stroke limit switch is defined that some axis' positive/negative limit uses a stroke switch,)

1. Please strictly connect as the following list:

Table 4-3-3

Address	Signal window	Window pin	Definition	
X000.0	XS40	1	The 1st stroke limit signal	Normally closed contact
X000.2	XS40	2	The 2nd stroke limit signal	Normally closed contact
X000.4	XS40	17	The 3rd stroke limit signal	Normally closed contact
X000.6	XS40	18	The 4th stroke limit signal	Normally closed contact

2. Rewriting the following parameters:

Table 4-3-4

Address	Definition	State 0	State 1	Setting value
K006.0	Whether to use 1 limit switch or not	2 PCS	1	1

Status parameter number

0	**1**	**1**	**BFA**	**LZR**						

LZR =1： Execute the stroke detection after power on before the manual

reference point return.
=0：Do not execute the stroke detection after power on before the manual reference point return.

BFA =1：When the overrun command occurs, the system alarms after overtravel.
=0：When the overrun command occurs, the system alarms before overtravel.

System parameter number

0 3 1			G13					

G13 =1： It is set to G13 mode during power-on or clearing the state.
=0： It is set to G12 mode during power-on or clearing the state.

System parameter number

0 6 1		LALM						

LALM =1： Ignore the limit alarm.
=0： Not ignore the limit alarm.

4.4 Gear Ratio Regulation

When the machine traverse distance doesn't comply with the movement distance displayed on the system coordinate, the system parameters P160~P163 and P165~P168 can be rewritten to change the electrical gear ratio, and then, the different mechanical transmission ratios can be applied.
Fractional frequency multiplication (the electrical gear) of the position code pulse should be set.
Computational formula:

$$G = \frac{\text{Numerator}}{\text{Denominator}} = \frac{4C}{L/\zeta} \times \frac{Z_M}{Z_D}$$

G: Electrical gear ratio;
L: Screw lead;
ζ :The minimum output code unit of the system(mm/pulse);
C: The linear/revolution of the photoelectric encoder.
$Z_{M:}$ The number of gear teeth at the end of the screw.
$Z_{D:}$ The number of gear teeth at the end of the motor. } With the change gear
System side:

Frequency of the numerator: NO.160, NO.161, NO.162, NO.163 of the system parameters (the code frequency multiplication coefficient).

Frequency of the denominator: NO.165, NO.166, NO.167, NO.168 of the system parameters (the code fractional frequency coefficient).

Drive unit side:

Frequency of the numerator: Parameter PA12 (The code frequency multiplication coefficient).

Frequency of the denominator: Parameter PA13 (The code fractional frequency coefficient).

【Example 1】If the screw lead is 8mm, the minimum output code unit of the system is 0.001mm, and the motor coder linear number is 2500, so:

$$G = \frac{4C}{L/\zeta} \times \frac{Z_M}{Z_D} = \frac{4 \times 2500}{8/0.001} \times \frac{1}{1} = \frac{5}{4}$$

Then, the data parameters NO. 160（CMRX）=5， NO.165（CMDX）=4;

The parameter setting of the system gear ratio is same as that of the digit servo gear ratio. If it is equipped with the digit servo with the electrical gear ratio function, the electrical gear ratio of the system is set as 1:1, and the calculated electrical gear ratio is set into the digit servo.

【Example 2】The formular of the gear ratio of the rotation axis:

$$G=\frac{N\times C\times 4}{P}=\frac{1\times 2500\times 4}{360\times 1000\times \text{reduction ratio（driving/passive tooth）}}$$

Note: the motor's optical encoder lines C＝2500.

4.5 Backlash Compensation

The dialgauge, the micrometer gauge or the laser can be used to measure; the backlash compensation should be compensated to improve the machining precision. Therefore, measuring the lead screw backlash in MPG or single step mode is not recommended, and the following method is suggested.

Editing a program:

O0001；

N10 G01 G91 X1 F800 ；

N20 X1 ；

N30 X1 ；

N40 X-1 ；

N50 M30 ；

The backlash error compensation value is set as 0 before measuring;

In the running program of a single block, find the measuring datum A after positioning two times, record the current data, run 1mm in the same direction, and then run 1mm to point B in opposite direction, finally read the current data.

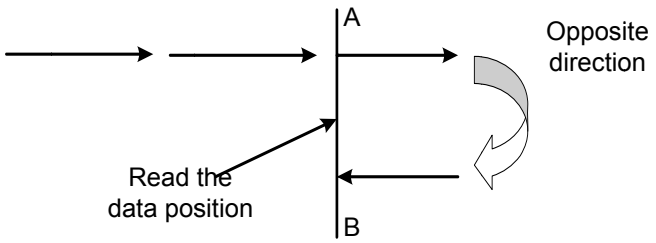


Fig. 4-5-1（Measuring method of the backlash）

The backlash error compensation value= | The data recorded by point A-the data recorded by point B|; The calculated data are input into the corresponding system parameters.

Data A: The data of dial gauge in Point A;

Data B: The data of dial gauge in Point B;

Pulse equivalent:1 micrometer.

Note 1: The backlash compensation amount of each axis is set by data parameters P190~P193.

Note2: The mode of backlash compensation amount and the compensation frequency are set by data parameters P195~P198.

Note 3: To guarantee the machine precision, the backlash can be detected again after the machine is unused for three months.

System parameter number

0	1	8	RVCS							RVIT

RVIT =1: When the backlash is greater than the gap allowance value, the next block is executed after the compensation is completed.
=0: When the backlash is greater than the gap allowance value, the next block is executed before the compensation is completed.
RVCS =1: The compensation mode of the backlash: up and down speed.
=0: The compensation mode of the backlash: the fixed frequency.

4.6 Settings Relevant to the Drive Unit

If the machine traverse direction isn't compliance with that required by the position movement code, the position parameter NO：3#1~ NO：3#3 can be rewritten.
System parameter numbers:

0	0	3					DIR4	DIR3	DIR2	DIR1

DIR1 =1： the 1st feed direction NOT(negation).
=0： the 1st feed direction is NOT(negation).
DIR2 =1： the 2nd feed direction NOT(negation).
=0： the 2nd feed direction is NOT(negation).
DIR3 =1： the 3rd feed direction NOT(negation).
=0： the 3rd feed direction is NOT(negation).
DIR4 =1： the 4th feed direction NOT(negation).
=0： the 4th feed direction is NOT(negation).

After power on, if the system displays the alarm of the 1st, 2nd, 3rd, 4thaxis or the spindle drive unit, firstly, check whether the drive unit alarms and the drive unit is connected or not. If there aren't above situations, the level set by the system alarm parameters should not match the alarm level of the drive unit, and the bit parameters NO:19#0 ~ NO:19#3 can be rewritten to set the high level valid or the low valid. If the customer also uses GSK drive unit, the bit parameters NO:19#0~NO:19#3 are set as 0. After rewriting the parameters, press <RESET> key to cancel the system alarm, and for safety, the parameter switch of the system should be set as "OFF".

If the drive unit doesn't provide the drive alarm signal, the signal can't be connected, and the state parameters NO：19#0 ~ NO：19#3should be set as 1 meanwhile. When the system displays the drive unit alarm, the operator should judge the fault on the system side or on the drive unit side.
System parameter number

0	1	9			ALMS		ALM4	ALM3	ALM2	ALM1

ALM1 =1: alarm when the 1st axis driver's alarm number is 1.
=0: alarm when the 1st axis driver's alarm number is 0.
ALM2 =1: alarm when the 2nd axis driver's alarm number is 1.
=0: alarm when the 2nd axis driver's alarm number is 0.
ALM3 =1: alarm when the 3rd axis driver's alarm number is 1.
=0: alarm when the 3rd axis driver's alarm number is 0.
ALM4 =1: alarm when the 4th axis driver's alarm number is 1.
=0: alarm when the 4th axis driver's alarm number is 0.

ALS1 =1: alarm when the 1st spindle driver's alarm number is 1.

=0: alarm when the 1st spindle driver's alarm number is 0.

System parameter number

0	6	1	FALM			SALM				

SALM =1: ignore the spindle drive unit alarm.

=0: do not ignore the spindle drive unit alarm.

FALM =1: ignore the feed axis driver alarm.

=0: do not ignore the feed axis driver alarm.

4.7 The Machine Screw Pitch Compensation

Relevant parameters with the pitch compensation

Table 4-7-1

System ——bit parameter				
No.	Bit	Parameter name	Parameter meaning	Default value
0037	Bit 0	SCRW	Whether the pitch error compensation function is valid	0

Table 4-7-2

System——data parameter		
Parameter number	Parameter meaning	Default value
0216	The 1st axis reference point's pitch error compensation number	0
0217	The 2nd axis reference point's pitch error compensation number	0
0218	The 3rd axis reference point's pitch error compensation number	0
0219	The 4th axis reference point's pitch error compensation number	0
0226	The 1st axis pitch error compensation interval	5.0000
0227	The 2nd axis pitch error compensation interval	5.0000
0228	The 3rd axis pitch error compensation interval	5.0000
0229	The 4th axis pitch error compensation interval	5.0000

Pitch compensation debugging flow

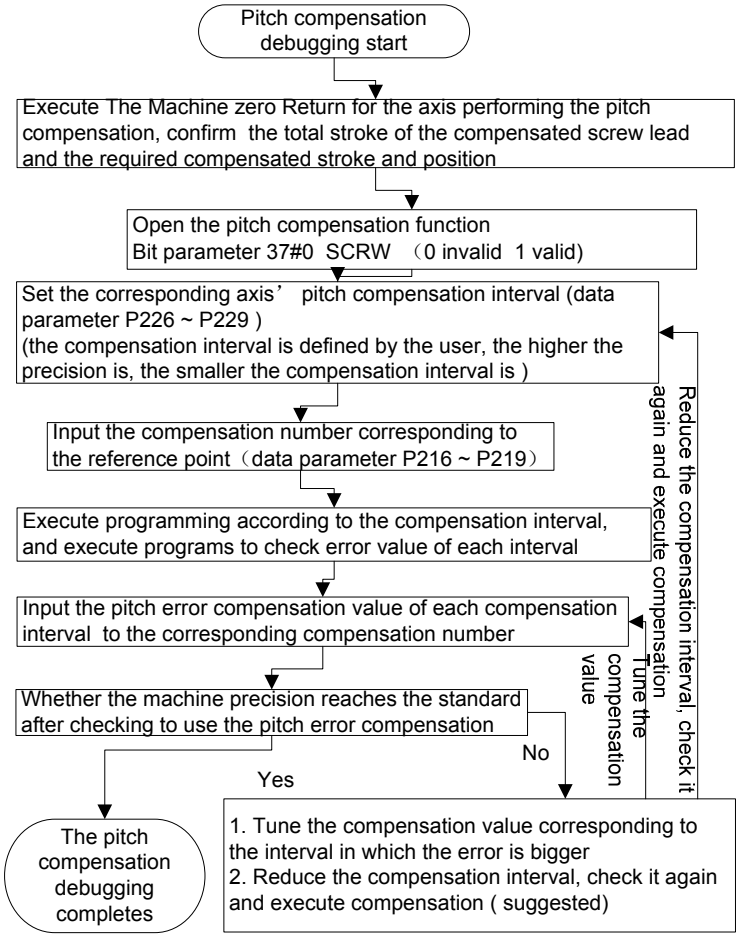

Pitch compensation debugging start
Execute The Machine zero Return for the axis performing the pitch compensation, confirm the total stroke of the compensated screw lead and the required compensated stroke and position
Open the pitch compensation function
Bit parameter 37#0 SCRW （0 invalid 1 valid)
Set the corresponding axis' pitch compensation interval (data parameter P226 ~ P229)
(the compensation interval is defined by the user, the higher the precision is, the smaller the compensation interval is)
Input the compensation number corresponding to the reference point（data parameter P216 ~ P219）
Execute programming according to the compensation interval, and execute programs to check error value of each interval
Input the pitch error compensation value of each compensation interval to the corresponding compensation number
Whether the machine precision reaches the standard after checking to use the pitch error compensation
No
Yes
Tune the compensation value
Reduce the compensation interval, check it again and execute compensation
The pitch compensation debugging completes
1. Tune the compensation value corresponding to the interval in which the error is bigger
2. Reduce the compensation interval, check it again and execute compensation (suggested)

Fig.4-7-1 pitch compensation debugging flow diagram

Each axis' pitch error compensation interval setting

990MC pitch error compensation uses a simple mode, confirming the end point's error compensation value of each compensation interval's positive movement and their corresponding compensation number to execute the compensation.

990MC's pitch compensation number is 0—255. 990MC omits the compensation point quantity,and the required compensation point is counted by " "the required set compensation point quantity=screw lead stroke/compensation interval". The user needs one of the compensation point quantity and the compensation interval, and another parameter can be determined by the screw lead stroke.

$$\text{Pitch error compensation interval} = \frac{\text{Screw lead's total stroke}}{\text{Custom compensation block quantity}}$$

$$\text{Custom compensation block quantity} = \frac{\text{Screw lead's total stroke}}{\text{Custom compensation interval}}$$

For example, the screw lead's stroke is 800mm, it is divided into 10 blocks to execute the pitch compensation, each block's interval is 80mm（80mm=800mm/10），the compensation interval value of P226~P229's corresponding aixs is set to 80. When the compensation value is input, only the compensation numbers 0—10 are input.

When the screw lead' stroke is 800mm and the user uses the interval 500 to execute compensation, P226~P229's corresponding axis' compensation interval is set to 50, but when the compensation value is input, only the compensation number 0——16 is input (16=800/50).

Note: the pitch compensation point quantity and interval are explained below (it may not be read in common mode):

When the 990MC system uses the pitch compensation, its 256 pitch compensation numbers are valid, the compensated machine coordinate position corresponded to each pitch compensation number is

counted according to the compensation interval. For a general screw lead' stroke only use some of pitch compensation number when the system uses the pitch compensation interval count.

For example, the compensation interval is set to 50mm，position of No. 10 compensation number is located at 500mm，position of No. 20 compensation number is located at 1000mm, position of No. 200 compensation number is located at 10000mm. The compensated position of some compensation number counted by the set compensation interval exceeds the screw lead's stroke. Even if the system runs to the coordinate position to execute compensation, the machine cannot run to the point, the user counts the set axis' storke range's compensation number according to the above method to meet the requirements.

Pitch error compensation number setting of each axis:

The reference point's compensation number, i.e., the mechanical zero position's compensation number.

Sequence of pitch compensation number develops gradually based on the machine coordinate value, the machine coordinate system's least value in the stroke range is located at No.0 compensation number, No. 1 compensatoin number's machine coordinate value is more than No.0's machine coordinate value. That is, the bigger the compensation point of the machine coordinate value is, the bigger the corresponding compensation number is.

Because of the machine axis' positive/negative zero return, the reference point position problem exist.

When the machine executes the negative zero return, it most strokes are more than the postitive value, the machine coordinate's least value is the mechanical zero, simultaneously, the corresponding reference point's pitch compensation number is set to 0.

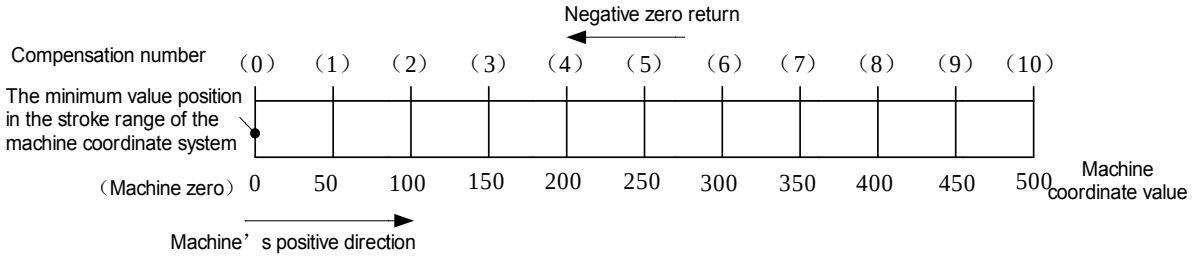

Negative zero return
Compensation number
(0) (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)
The minimum value position in the stroke range of the machine coordinate system
(Machine zero) 0 50 100 150 200 250 300 350 400 450 500
Machine coordinate value
Machine's positive direction

Fig.4-7-2 negative zero return's reference point compensaton number explanation

When the machine executes the positive zero return, the mechanical zero is located at the maximum value of the machine coordinate system, the screw lead's stroke is negative, so, the minimum value of the screw lead is the fastest and the minimum value position is No.0 compensation number, at the moment, when the screw lead is divided into 10 to execute compensation, the reference point's compensation number is set to 10.

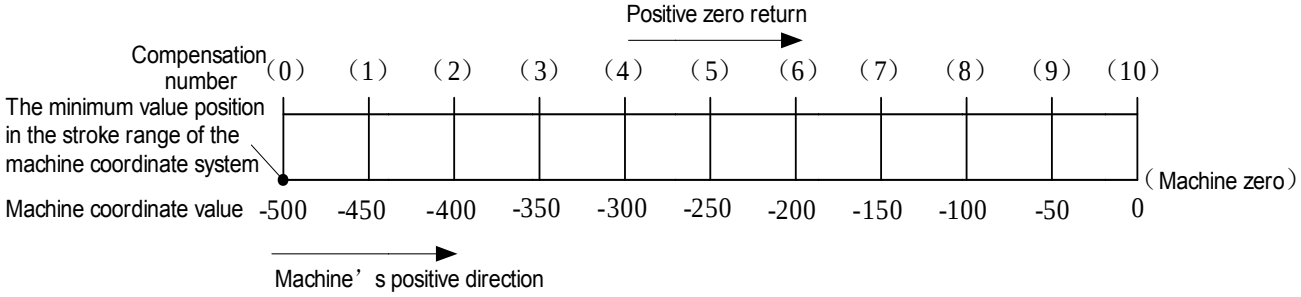

Positive zero return
Compensation number
(0) (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)
The minimum value position in the stroke range of the machine coordinate system
(Machine zero)
Machine coordinate value -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
Machine's positive direction

Fig. 4-7-3 positive zero return's reference point compensaton number explanation

Note: the pitch error compensation number of reference point are explained below (it may not be read in common mode):

For the pitch compensation, each pitch compensation number corresponds each axis' machine coordinate value's position to complete its compensation. So, after the mechanical zero is confirmed, these pitch compensation number can execute its compensation according to its machine coordinate value.

The reference point compensation number is a positioning of these compensation number. After confirming the reference point compensation number, the system executes addition/subtraction by the set compensation interval according to the reference point compensation number's position, which can count other compensation number's position. These compensation numbers order

gradually in the machine coordinate position.

Example: when the reference point compensation number is set to No.10, its compensation number's position in the machine coordinate system is 0. When the compensation interval is set to 50mm， No.9 compensation number's machine coordinate position is -50mm（-50mm=0-50mm），No. 8's is -100mm（-100mm=0-50*2mm），in the another direction, No.11 compensation number's position is 100mm（100mm=0+50*2mm）, finally, the user can compensate the coordinate value within the screw lead' stroke.

As the above figure, when the reference point compensation number is set to 10 and the compensation interval is 50mm, the screw lead's stroke is -200mm~0mm，the user inputs only the pitch compensation value to No. 6, 7, 8, 9, 10 pitch compensation values. In a similary way, when the screw lead's stroke is 0~200mm，the reference point compensation number is set to 10, the No. 14 pitch compensation number's position is 200mm，the user needs to set only No. 10, No.11, No.12, No.13, No.14.

Measured pitch compensation data corresponded to compensation number explanation:

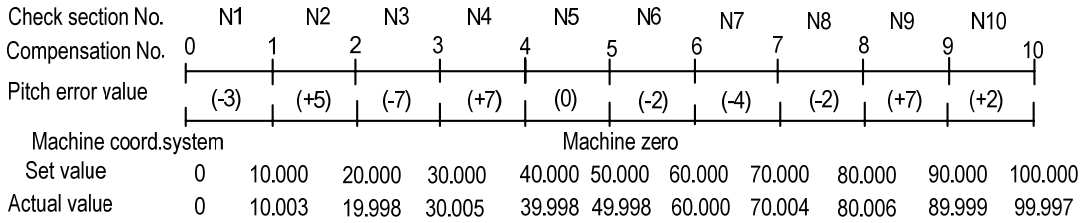


Fig.4-7-4 measured pitch compensation data

Corresponding relationship between pitch error compensation amount and compensation numbers is shown in Fig. 4-7-3：

Table 4-7-3

Compensation number	0	1	2	3	4	5	6	7	8	9	10
Compensation amount	0	-3	+5	-7	+7	0	-2	-4	-2	+7	+2

The error check can be performed after the distance between the least value and the most value of the machine table movement stroke is divided into N sections; the pitch error of each interval is fixed, regardless of the control of the table movement direction. For example, Fig. 4-7-4 shows that the error value in the N1 area should be input to the corresponding compensation series number "1" for the system, in this case, the system then can be correctly called the pitch error compensation value in the N1 area. The error value of N6 area in the Fig. 4-7-3 inputs to the corresponding position of compensation series number "6", in this way, the system can be correctly called the pitch error compensation value in the N6 area. Therefore, its relationships that the pitch error value in each area is corresponding to the end position of its area along with positive movement.

Pitch compensation value input steps:

Press

to enter the system page including【⊞OFT】, 【⊞PARA】,【⊞MACRO】,【PITCH】, 【⊞SERVO】, and then press【PITCH】to enter the pitch error compensation page:

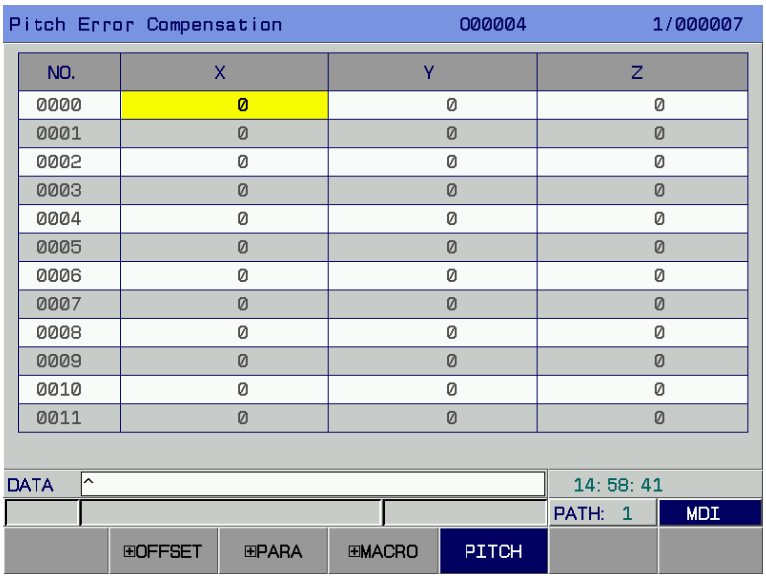


Fig.4-7-5 pitch compensation window

Directly inputting each axis' each point compensation value is shown below:

1) Select MDI mode; ;

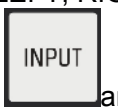
2) Press

, and then press the soft key【Password】to enter the page【set(Password)】, input the system password which is above system debugging password.

3) Press【Set】to enter【Set】page to open the parameter switch.

4) Press

and then press【Pitch】to enter the pitch error compensation display window;

5) Press the direction key UP, DOWN, LEFT, RIGHT to position the cursor to the target position, input the compensation value, press 

and the input value is dpslayed.

Precautions set by the pitch error compensation

1. The set compensation amount is related with the position relationships between the zero and compensation point, the mechanical movement direction and compensation interval, etc.
2. The compensation amount of the compensation point N (N=0, 1, 2, 3, ……255) is determined by mechanical error of the area N, N-1. The compensation point number along with each axis can be set to 256.
3. The mechanical zero is regarded as the compensation origin, and the compensation data set by each axis is set as the parameter value.
4. The axes can be compensated: X, Y, Z and the 4th.
5. The range of the compensation amount: compensation value (-999 pulse equivalent~ +999 pulse equivalent) x the least compensation unit. (Metric system: 0.001mm; Inch system: 0.0001 inch; angle: 0.001deg).
6. The unit of the pitch error compensation of the rotation axis is deg.
7. The system ignores the compensation when pitch error compensation interval is set to 0. (The pitch error compensation is performed near the middle point of the compensation area)
8. After the related parameter of the pitch error compensation is set, and it can be enabled when its power restarts and the machinery zero performs.
9. The machinery zero of the tool can not be altered freely after the pitch compensation is performed, that is, the position of the pitch compensation may inconsistent with the one of the machine's actual compensation, and therefore, the machine accuracy is then decreased. If it is necessary to set the machinery zero again for some special reasons, the data of pitch error compensation should be inspected again accordingly.

10. The pitch error compensation data can be set for compensating the pitch error along with each axis, and therefore, enhance the machine accuracy, and its unit of the compensation value is the inspection unit. The pitch error is varied from one machine to another, so did the compensation data. In principle, the final user can not alter these data after the pitch error compensation data are set; and therefore, the machine accuracy may reduce by changing these data.

An example of a linear axis pitch error compensation
X axis is regarded as an example of a linear axis, the setting method of other axes are identical.
Zero return along with positive direction, the error compensation is performed the inspection based upon that the mechanical zero regards as reference point.
It is supposed that the actual situation is: the pitch error compensation interval is 10mm, the stroke along with X axis is 100mm, the relative data parameter setting is shown in the table 4-7-4:

Table 4-7-4

Parameter	Default setting	Actual setting
216：the 1st reference point's compensation number	0	10
226：the 1st pitch error compensation interval	5	10

The actual measure value is as the Fig. 4-7-6:

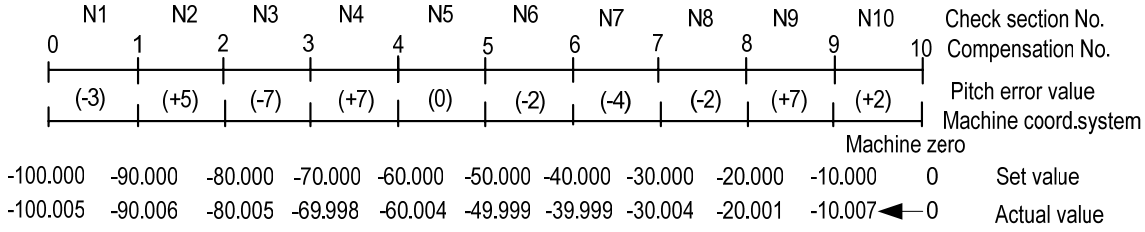


Fig. 4-7-6 measured pitch compensation data

In this case, the pitch error compensation value along with X axis in the system is shown in the table 4-7-5:

Table 4-7-5

Compensation number	0	1	2	3	4	5	6	7	8	9	10
Compensation value	0	+1	-1	-7	+6	-5	0	+5	-3	+6	-7

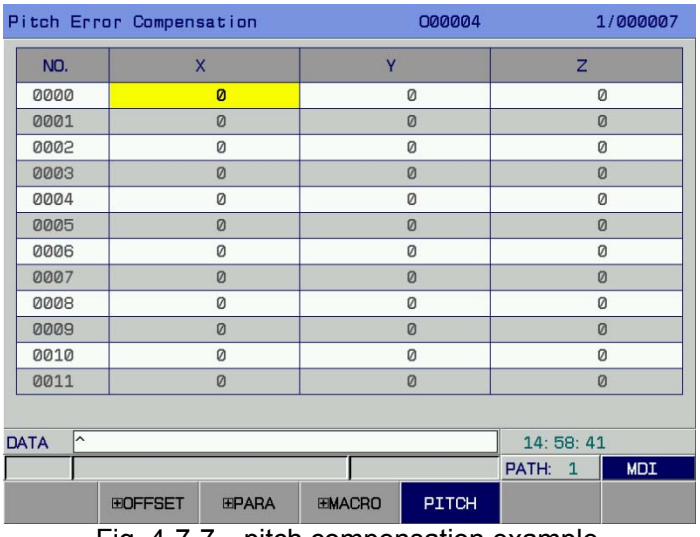


Fig. 4-7-7 pitch compensation example

Zero return along with the negative direction, the error compensation is performed the inspection based upon that the mechanical zero treats as reference point.
It is supposed that the actual situation is: the interval of the pitch error compensation is 10mm, the stroke along with X axis is 100mm, and the relative data parameter setting is shown in the Table

4-7-6:

Table 4-7-6

Parameter	Default setting	Actual setting
216：the 1st reference point's compensation number	0	0
226：the 1st pitch error compensation interval	5	10

Actual measurement value is shown in Fig. 4-7-8:

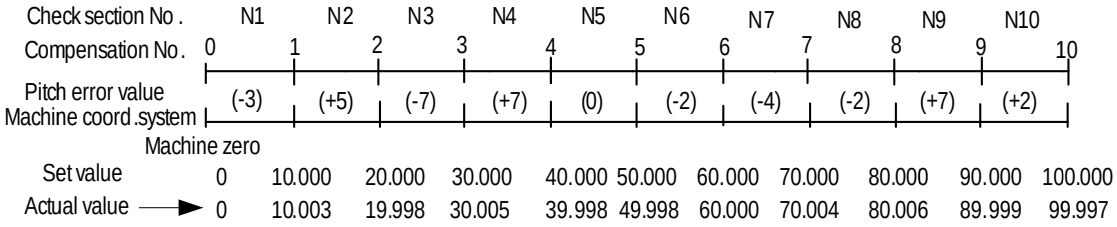


Fig. 4-7-8 measured pitch compensation data

In this case, the pitch error compensation value along with X axis in the system is set as the Table 4-7-7:

Table 4-7-7

Compensation number	0	1	2	3	4	5	6	7	8	9	10
Compensation value	0	-3	+5	-7	+7	0	-2	-4	-2	+7	+2

The mechanical zero locates on the middle of the stroke, the error compensation performs inspection based upon that the mechanical zero treats as reference point.

It is supposed that the actual situation is: the pitch error compensation interval is 10mm, X axis' stroke is 100mm, the positive limit value along with the negative is -50~+50, the relative data parameter setting is shown in the table 4-7-8:

Table 4-7-8

Parameter	Default setting	Actual setting
216：the 1st reference point's compensation number	0	5
226：the 1st pitch error compensation interval	5	10

The actual measure value is shown as Fig.4-7-9:

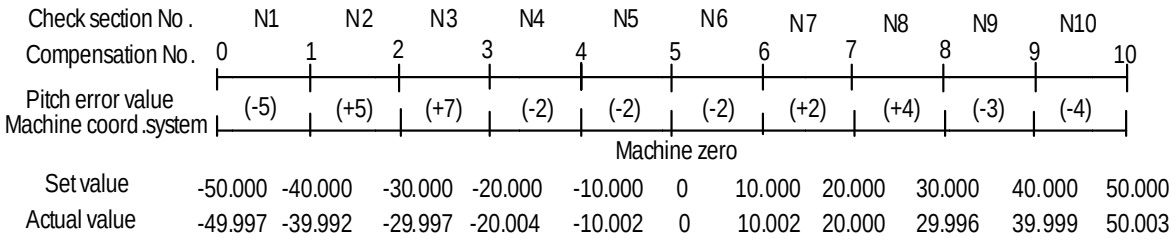


Fig. 4-7-9 measured pitch compensation data

In this case, the pitch error compensation value along with X axis in the system is set as the Table 4-7-9:

Table 4-7-9

Compensation number	0	1	2	3	4	5	6	7	8	9	10
Compensation value	0	-5	+5	+7	-2	-2	-2	+2	+4	-3	-4

Rotation axis' pitch error compensation example:

Rotation axis' pitch error example, the character of the rotation axis is overlapped of its start and end position, so, values of No. 0 compensation value and No. 6 compensation value are consistent, and its shifting value of each revolution is 360 degree, which is divided into N areas; refer to Fig. 4-7-10:

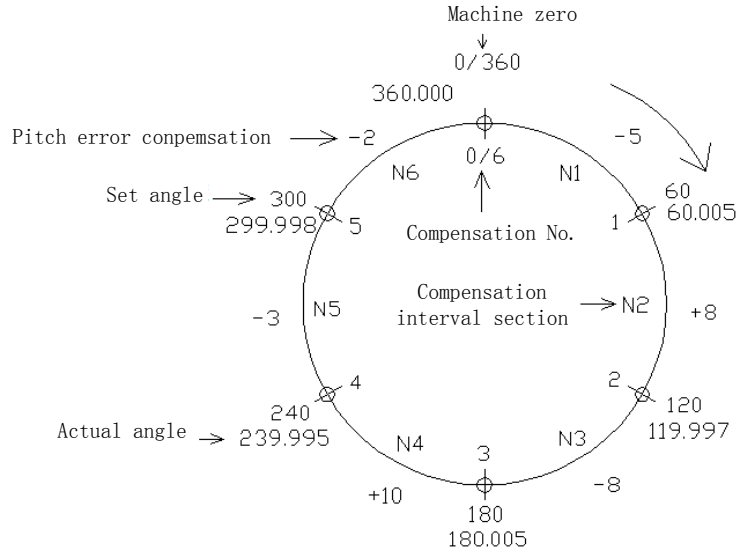


Fig. 4-7-10 rotation axis' pitch compensation

Unfolding Fig.4-7-10 appears the following figure (Fig. 4-7-11) :

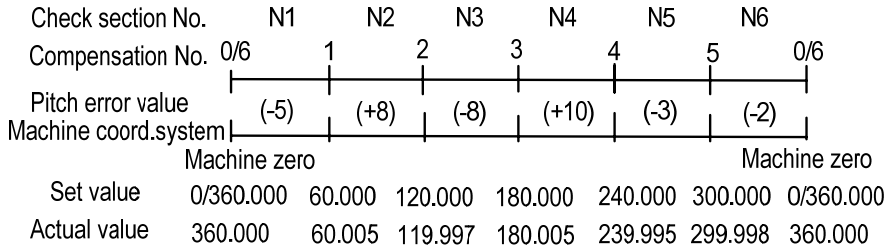

Check section No. N1 N2 N3 N4 N5 N6
Compensation No. 0/6 1 2 3 4 5 0/6
Pitch error value (-5) (+8) (-8) (+10) (-3) (-2)
Machine coord.system
Machine zero
Machine zero
Set value 0/360.000 60.000 120.000 180.000 240.000 300.000 0/360.000
Actual value 360.000 60.005 119.997 180.005 239.995 299.998 360.000

Fig. 4-7-11 rotation axis' pitch compensation' measured data

In this case, the compensation amount of both the compensation start and end are shared with same area, and therefore, the start and end of the compensation value are set to same. The shifting value of each revolution is 360 degree based upon the character of the revolving axis; the compensation amount of the overall compensation areas are 0 (that is, N1+N2+……+N6=0), if they are not 0, the pitch error of each rotation will be accumulated, so that the position offset occurs. The more along with the equidirectional rotation is, the bigger of the position offset value is. Refer to the Fig. 4-7-11 for the pitch error compensation. In this moment, the parameter setting of the pitch error data in the system is shown in the Table 4-7-10:

Table 4-7-10

Parameter	Default setting	Actual setting
219：the 4th reference point's compensation number	0	0
226：the 4th pitch error compensation interval	5	60

In this case, the pitch error compensation value of the rotation axis (An axis) in the system is set as Fig. 4-7-11:

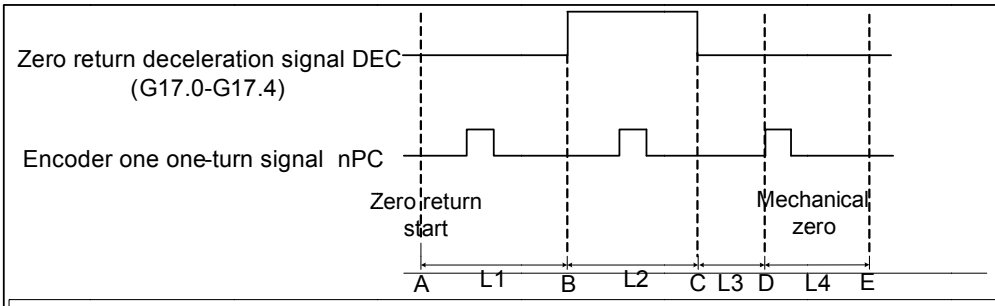
Table 4-7-11

Compensation number	0	1	2	3	4	5	6
Compensation value	-2	-5	+8	-8	+10	-3	-2

Note: in the above table, the rotation axis' No.0 compensation value is consistent with that of No.6, so, the input compensation value must be consistent, one of then is needed during counting, all compensation interval total is always 0.

4.8 Mechanical Zero Return (Mechanical zero Return)

The concept of mechanical zero point(mechanical zero point)
The machine coordinate system is the fixed one on the machine. And the origin of the machine coordinate system is called as the mechanical zero point (or the mechanical zero point). In this manual, it is also called as the reference point, and always installed in the maximum limit of X,Y 4th axis. After the machine is designed, manufactured and adjusted, the machine is set up and fixed. However, after CNC power on, there isn't the mechanical zero point, and the zero point is obtained in AUTO or JOG mode.
There are two types of zero return:1. after a block; 2. before a block, which are set by bit parameter N0: 6#1.
There are two types of zero return:1. with one-turn signal; 2. without one-turn signal, which are set by bit parameter N0: 6#6.
During zero return, if there isn't one-turn signal in the motor, zero mode type is classified as type A or B, which are set by bit parameter N0:6#7.

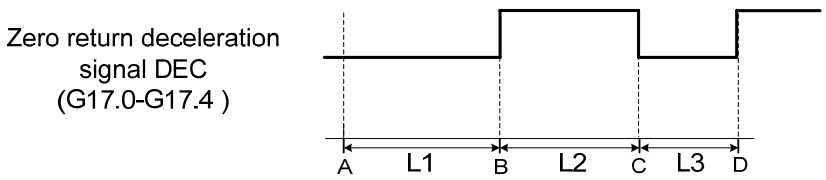


When the servo motor with code is used (Set parameter NO.6#6=1, type A/B block, the logic before/after the block are same)
System performs the mechanical zero, machine slide moves toward to the set zero return direction, its distance is L1, velocity is data parameter P100-104. The acceleration/deceleration time constant is data parameter P352 (all-axle current). The zero return deceleration signal G17.0-G17.4 are enabled when the zero return switch senses to the zero return block. The system decelerates to the setting of data parameter P342-P346; The acceleration/deceleration time Constant is data parameter P353 (All-Axle current). The system is immediately decelerates to the velocity set by data parameter P99 when the sense switch leaves the block and waiting for the code OneTurn signal (nPC); the system stops after receiving the nPC signal. The system is then regarded as this point (point D) as the mechanical zero. Finally, the zero return executes.

Notice:
1. Adjust the parameters P100-104 and P352 to ensure the ON/OFF stability on L1 block.
2. Adjust the parameters P100-104 and P353 to ensure that the system vibration does not occur when decelerating to L2 block (point B) from L1 ; and guarantee to the deceleration velocity set by data parameters P342-P346 on the L2 block.
3. Ajust the parameters P342-P346 to ensure that the system vibration does not generate when decelerating to L3 block from the L2.
4. To ensure the accuracy of zero return, it is recommended that the distance of L3 should be more than or equals to 2mm.
5. If the system is set as the zero return before the block, it moves negatively based upon the velocity set by data parameters P342-P346 after the system decelerates to 0 on L2 block.
6. If the lattice offset function are required (only for the movement direction offset on L3 block), the data parameters P180-183 are set as the required offset distance (L4, unit: mm). The point E is treated as mechanical zero when system zero return performs.

The signal time-sequence figure when using a servo motor with an encoder: A/B zero return method

Fig. 4-8-1



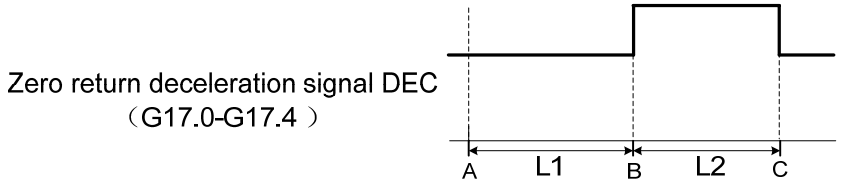
When using the step motor (Set the position parameter NO.6#6=0):
The machine slide moves along with the set zero return when the system performs mechanical zero return, its distance is L1. Zero velocity is the data parameter P100-104. The acceleration/deceleration time constant is the data parameter P352 (all-axle current). The zero return deceleration signal G17.0-G17.4 is enabled when the zero return Switch senses to the zero return block. The system is immediately decelerate to the velocity set by data parameter P99 when the sense switch Leaves from the zero return block. The system is immediately Stopped and regarded as this point (D) as the mechanical zero when the deceleration signal is enabled again. The zero return is then performed.

Notice:

1. Adjust the parameters P100-104 and P352 to ensure the ON/OFF stability on L1 block.
2. Adjust the parameters P100-104 and P353 to ensure That The system vibration does not occur when decelerating to L2 block (point B) from the L1, and guarantee decelerating the velocity set by data parameters P342-P346 on L2 block
3. Adjust the parameter P342-P346 to ensure that the system vibration does not occur when decelerating to L3 block from the L2.
4. If the system set as the zero return before the block, then the system on the L2 block decelerates to 0 and then moves based upon the velocity set by data parameter P99 reversely.

The signal time sequence figure using the step motor without the encoder: Type A zero return method

Fig.4-8-2



When the step motor is used (Set position parameter NO.6#6=0):
The machine tool Slide moves toward the set zero direction when the system performs mechanical zero return, it’ s distance is L1. the velocity is data parameter P100-104. The acceleration/deceleration time constant is the data parameter P352 (All axle current). The zero return deceleration signal G17.0-G17.4 is enabled when the zero return switch senses its block. The system decelerates to the velocity set by data parameter P342-P346. The acceleration time Constant is Data Parameter P353 (all axle current). The system is immediately stopped and regarded this point (C) as mechanical zero. Finally, the zero return is executed.

Notice:

1. Adjust the parameters P100-104 and P352 to ensure the ON/OFF stability on L1 block.
2. Ajust the parameters P100-104 and P353 to ensure that the system vibration does not occur when L1 decelerates to L2 block (point B). Guarantee decelerating to the velocity set by data parameters P342-P346 on L2 block.
3. Adjust the parameters P342-P346 to ensure that the system vibration does not occur when the L2 block decelerates to the L3 (point C).
4. It is suggested that the parameters P342-P346 are set to small as much as possible for guarantee the zero return accuracy, its recommended value is 40.
5. If the system set the zero return before the block, then the system decelerates to 0 and moves based upon the velocity set by data parameters P342-P346 reversely.

Signal time sequence figure using the step motor without encoder: Type B zero return method

Fig.4-8-3

1. The operation steps of the pulse servo mechanical zero return

（1）Press

to enter the mechanical zero return mode, and then “mechanical zero return” is displayed at the bottom right corner on LED screen.

（2）Select X, Y or 4th axis for mechanical zero return, and zero return direction is set by bit parameters N0:7#0～N0:7#3.

（3）The machine moves along the mechanical zero point, before the deceleration point, the machine traverses rapidly, and the traverse speed is set by the data parameters **P100～P103**. After touching the deceleration switch, each axis returns to the mechanical zero point (the reference point) at the speed set by P342~P345. After separating from the block, move the mechanical zero at the speed FL (data parameter P099). During returning the mechanical zero point, the coordinate axis stops moving, the zero return indicator is ON.

Example:

Taking an example of the 1st axis’ common incremental zero return, the 1st axis strikes the block at the speed F4000（the data paramete P100 is set to 4000），it passes the block after encountering the deceleration switch at F500（the data parameter P342 is set to 500）. After it leaves the block, the 1st axis searches one-totation Z pulse signal at the speed F40（the data parameter P99 is set to 40）, and it stops after it receives the signal, which is shown in Fig. 4-8-4.

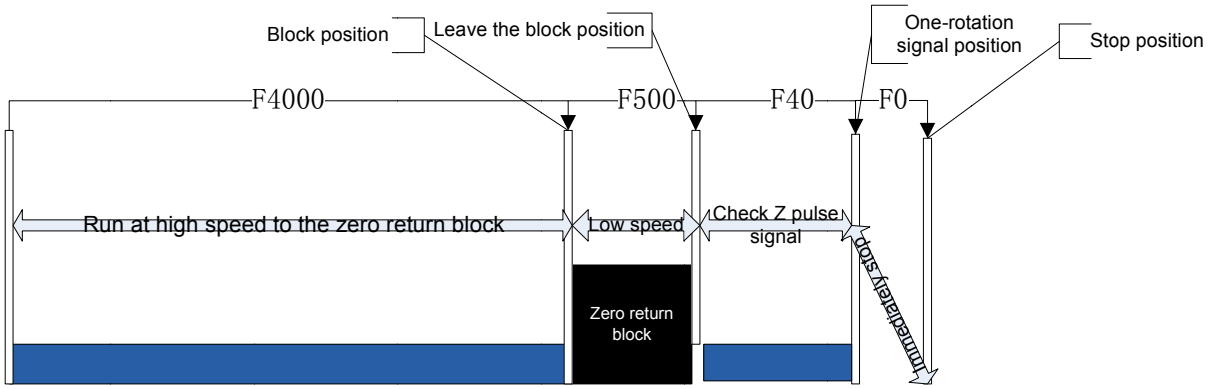


Fig. 4-8-4

2. Using the program code mechanical zero’s operation steps

After NO：6#3 is set to 0, using the program code G28 executes the zero return because checkingthe stroke block equals to the manual mechanical zero return.

Note 1: when a zero return switch is not installed on the machine or a machine (mechanical) zero is not set, the mechanical zero return cannot be executed.

Note 2: when the mechanical zero return is completed, the corresponding axis’ indicator is ON.

Note 3: when the corresponding axis is not on the mechanical zero return’s indicator is OFF..

Note 4: the mechanical zero(i.e., reference point)’s direction is referred to the machine manufacturer’s User Manual.

Note 5：after the mechanical zero is set, each axis’ zero return direction, feed axis’ direction and gear ratio must not be modified.

Relevant signals

DECX：X deceleration signal;

DECY：Y deceleration signal

DECZ：Z deceleration signal;

DEC4：the 4th deceleration signal;

System diagnosis（input state at side of the machine）

State address					**X1.3**	**X1.2**	**X1.1**	**X1.0**
Pin					**XS40.22**	**XS40.09**	**XS40.21**	**XS40.08**

System parameter number

0	**0**	**6**	**MAOB**	**ZPLS**		**SJZ**			**ZMOD**		

ZMOD =1: the zero return mode: before the block.

=0: the zero return mode: after the block.

SJZ =1：The reference point memory: memory.

=0：The reference point memory: not memory.

ZPLS =1: Zero return mode selection: with one-turn signal.

=0: Zero return mode selection: without one-turn signal.

MAOB =1: Zero return mode without one-turn signal: Mode B;

=0: Zero return mode without one-turn signal: Mode A.

System parameter number

0	**0**	**7**					**ZMI4**	**ZMI3**	**ZMI2**	**ZMI1**	

ZMI1 =1: Setting the 1st axis reference point return direction: negative.

=0: Setting the 1st axis reference point return direction: positive

ZMI2 =1: Setting the 2nd axis reference point return direction: negative.

=0: Setting the 2nd axis reference point return direction: positive

ZMI3 =1: Setting the 3rd axis reference point return direction: negative.

=0: Setting the 3rd axis reference point return direction: positive

ZMI4 =1: Setting the 4th axis reference point return direction: negative.

=0: Setting the 4th axis reference point return direction: positive

Data parameter No.099

0	**9**	**9**	Gain Z pulse signal's (FL) speed(for all axes)

Data parameter No.100～No.103

1	**0**	**0**	The 1st axis reference point return's speed
1	**0**	**1**	The 2nd axis reference point return's speed
1	**0**	**2**	The 3rd axis reference point return's speed
1	**0**	**3**	The 4th axis reference point return's speed

Data parameter No.342～No.345

3	**4**	**2**	Speed when the 1st axis zero return with low-speed
3	**4**	**3**	Speed when the 2nd axis zero return with low-speed
3	**4**	**4**	Speed when the 3rd axis zero return with low-speed
3	**4**	**5**	Speed when the 4th axis zero return with low-speed

Data parameter No.352～No.353

3	**5**	**2**	Acceleration/decleration time constant of zero return with high-speed
3	**5**	**3**	Acceleration/decleration time constant of zero return with low-speed

Data parameter No.354

3	**5**	**4**	Speed of zero return deceleration stop to return to the mechanical zero with low speed

Data parameter No.180～No.183

1	**8**	**0**	Grid offset amount or reference point offset amount of the 1st axis
1	**8**	**1**	Grid offset amount or reference point offset amount of the 2nd axis

1	**8**	**2**	Grid offset amount or reference point offset amount of the 3rd axis
1	**8**	**3**	Grid offset amount or reference point offset amount of the 4th axis
1	**8**	**4**	Grid offset amount or reference point offset amount of the 5th axis

Data parameter No.347～No.350

3	**4**	**7**	The 1st reference point's absolute position when the absolute rotation encoder is used
3	**4**	**8**	The 2nd reference point's absolute position when the absolute rotation encoder is used
3	**4**	**9**	The 3rd reference point's absolute position when the absolute rotation encoder is used
3	**5**	**0**	The 4th reference point's absolute position when the absolute rotation encoder is used

4.9 The Spindle Rotation (CW/CCW) Input/Output Signal Control

Relevant signals
M03: The spindle CW rotation
M04: The spindle CCW rotation
M05:The spindle stops
SON: The spindle enable
SAR: The spindle speed arrival
ZSP: The spindle zero speed detection
COIN: The spindle orientation in-position

System diagnosis（output state at side of the system）

State address						**Y6.2**	**Y6.1**	**Y6.0**
Pin						**XS23.24**	**XS23.25**	**XS23.09**

Y6.0=the spindle rotation signal output(CW)；Y6.1= the spindle rotation signal output(CCW)；Y6.2=the spindle enabling.

State address						**Y6.2**		
Pin						**XS23.24**		

Y6.2= the spindle enabling
System diagnosis（input state at side of the system）

State address					**X7.3**	**X7.2**	**X7.1**	**X7.0**
Pin					**XS23.20**	**XS23.05**	**XS23.21**	**XS23.44**

X7.2=the spindle speed arrival signal input；X7.3＝the spindle zero-speed check signal input；
X7.2=the spindle speed arrival signal input；
X7.3=the spindle zero-speed check recognizing number input.

State address							**X7.1**	**X7.0**
Pin							**XS23.21**	**XS23.44**

X7.0=speed/position switch completion signal；X7.1=spindle orientation completion signal.
System parameter number

0	**3**	**8**	**PG2**	**PG1**					

Gear ratio between PG2 & PG1 spindle and the position encoder.

$$\text{Gear ratio} = \frac{\text{Position encoder speed}}{\text{Spindle speed}}$$

Gear ratio	PG2	PG1
×1	0	0
×2	0	1
×4	1	0
×8	1	1

System parameter number

0	**4**	**4**							**VGR**	

VGR =1: The gear ratio of the spindle and position encoder can be performed freely.
=0: Do not freely perform the gear ratio between the spindle and position encoder.

Data parameter No.257

2	**5**	**7**	Spindle rotation upper-limit during tapping cycle

Data parameter No.258

2	**5**	**8**	Spindle rotation upper-limit

Data parameter No.286～No.288

2	**8**	**6**	Gear number at the side of the spindle (the 1st gear)
2	**8**	**7**	Gear number at the side of the spindle (the 2nd gear)
2	**8**	**8**	Gear number at the side of the spindle (the 3rd gear)

Data parameter No.290～No.292

2	**9**	**0**	Gear number at the side at the encoder(the 1st gear)
2	**9**	**1**	Gear number at the side at the encoder(the 2nd gear)
2	**9**	**2**	Gear number at the side at the encoder(the 3rd gear)

Operation sequence

The spindle operation sequence is shown in Fig.4-9-1：

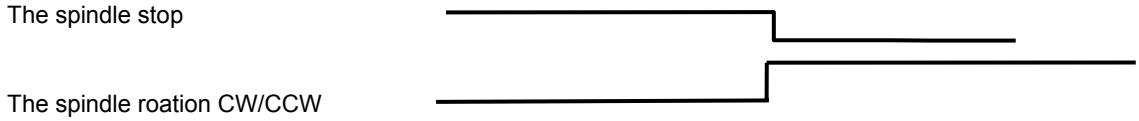


Fig. 4-9-1 Sequence of the spindle rotation CCW

Control logic

When the system is turned on, the spindle stops, M05 signal output remains;
After M3/M4 is executed, M3/M4 is valid and remains and M05 signal closes output;

4.10 The Spindle Gear Change Control

Relevant signals
Y3.4～Y3.6：The spindle's automatic gear change output signal.
X4.1～X4.3：The spindle gear change in-position signal.
When the spindle frequency conversion (0~10V analog voltage output) controls, the system can support the spindle automatic gear change control with three gears and the gear change in-position detection function with three gears.

Signal diagnosis
System diagnosis（input state at side of the machine）

State address		**Y3.6**	**Y3.5**	**Y3.4**				
Pin		**XS44.25**	**XS44.12**	**XS44.24**				

X3.4=the spindle No. 1 gear output; X3.5= the spindle No. 2 gear output; X3.6= the spindle No. 3 gear output.
System diagnosis（input state at side of the machine）

State address					**X4.3**	**X4.2**	**X4.1**	
Pin					**XS42.15**	**XS42.02**	**XS42.14**	

X4.1=the spindle No. 1 gear in-position; X3.5= the spindle No. 2 gear in-position; X3.6= the spindle No. 3 gear in-position.

Control parameter

State parameter

0	0	1						SPT		

SPT =1: the spindle control type ： I/O point control.

=0: The spindle control type: frequency conversion or other mode.

Data parameter No.246

2	4	6	The maximum speed corresponding to gear 1

When the spindle is in No. 1 gear, the maximum speed is the spindle one when the transducer is corresponding to 10V voltage.

Data parameter No.247

2	4	7	The maximum speed corresponding to gear 2

When the spindle is in No. 2 gear, the maximum speed is the spindle one when the transducer is corresponding to 10V voltage.

Data parameterNo.248

2	4	8	The maximum speed corresponding to gear 3

When the spindle is in No. 1 gear, the maximum speed is the spindle one when the transducer is corresponding to 10V voltage.

Data parameterNo.250

2	5	0	Motor speed when the spindle gear performs gear change

The speed relative to the data parameter No.251.

Data parameterNo.251

2	5	1	The maximum speed when the spindle gear performs gear change

The motor's speed when the transducer corresponds to 10V.

Note:

1. When the machine is with the automatic gear change device, K8.4 is set to 1; otherwise, 0. When the automatic gear change is invalid, the maximum speed of gear 1 is defaulted and 246≥247≥248.

2. When the spindle gear detection isn't with the detection switch, K7.3 should be set to 1; otherwise, 0.

3. When the spindle is I/O point control, K4.0 should be set to 1.

4.11 The External Cycle Start and Feed Hold

Relevant signals

ST: The external automatic cycle start signal, and it is same as the function of the automatic cycle start key on the machine panel.

*SP: Feed hold signal, and it is same as the function of the feed hold key on the machine panel.

Signal diagnosis

System diagnosis（input state at side of the system）

State address		X1.6	X1.5					
Pin		XS40.25	XS40.12					

X1.5= The external cycle start X1.6= The external feed hold

The signal's internal connection

*SP/ST signal internal circuit is referred to the following Fig. 4-11-1:

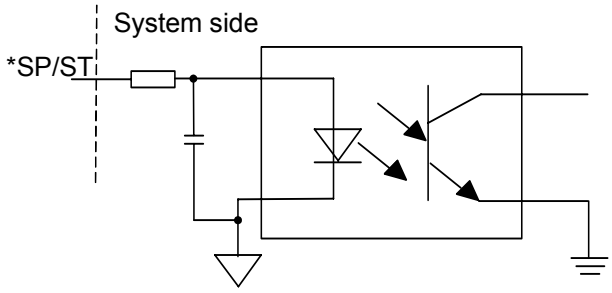


Fig.4-11-1

The external circuit
The connection between *SP and ST signals is referred to the following Fig. 4-11-2.

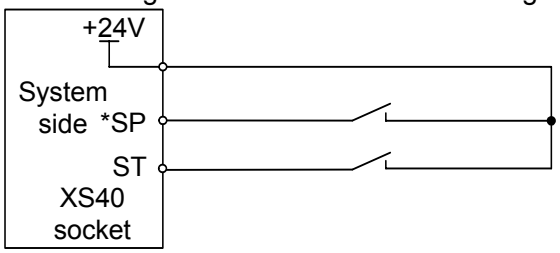


Fig. 4-11-2

Modifying the following parameter

Address	Definition	State 0	State 1	Setting value
K005.1	Whether the machine is with the external cycle start	No	Yes	1

4.12 External Edit Lock and External Operation Panel Lock

Relative signals
LEDT: The external editing lock signal. When the signal is 1, the program can be edited, and it is same as the function of the program switch on the system.
LSYS: The external operation panel lock signal. When the signal is 1, the overall operation keys on the machine are locked.
Signal address

	#7	#6	#5	#4	#3	#2	#1	#0
G016	**LSYS**	**LEDT**						

Parameter diagnosis (Input state at the side of the system)

Status address							**X3.1**	**X3.0**
Pin							**XS41.21**	**XS41.8**

X3.0= External edit lock X3.1= External operation panel lock

System parameter number

0	**5**	**9**		**LEDT**	**LOPT**					

LOPT =1: the panel operation lock signal is valid.
=0: the panel operation lock signal is invalid.
LEDT =1: the external program lock signal is valid.
=0: the external program lock signal is invalid.

4.13 Cooling, Lubricating，Chip Removal Control

Relevant M codes

M08：cooling ON.

M09：cooling OFF.

M35：chip removal function ON.

M36：chip removal function OFF.

Signal diagnosis

Parameter diagnosis（output state at side of the system）

State address							Y0.1	
Pin							XS43.14	

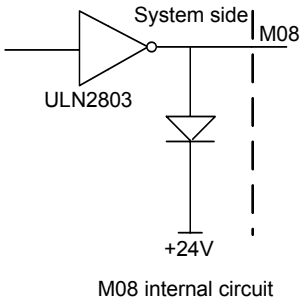
Y0.1=cooling ON/OFF control.

Parameter diagnosis（output state at side of the system）

State address						Y1.2	Y1.1	
Pin						XS43.9	XS43.21	

Y1.1=chip removal ON/OFF control；Y1.2=lubricating ON/OFF control.

The internal circuit is referred to the following Fig. 4-13-1:



M08 internal circuit

Fig. 4-13-1 M08 internal circuit

4.14 Setting Related Feedrate

System parameter number

0	1	2	RDR	FDR	TDR	RFO			LRP	RPD

RPD =1: Before connecting the power supply and the reference point return, the rapid in JOG mode is valid.

=0: Before connecting the power supply and the reference point return, the rapid in JOG mode is invalid.

LRP =1: Positioning (G00) interpolation type is linear.

=0: Positioning (G00) interpolation type is non-linear.

RFO =1: Rapid feeding, when the feed override is Fo, the feeding stops.

=0: Rapid feeding, when the feed override is Fo, the feeding doesn't stop.

FDR =1: During cutting feed, dry run is valid.

=0: During cutting feed, dry run is invalid.

RDR =1: During rapid positioning, dry run is valid.

=0: During rapid positioning, dry run is invalid.

RPD =1: Before connecting the power supply and the reference point return,

the rapid in JOG mode is valid.

=0: Before connecting the power supply and the reference point return, the rapid in JOG mode is invalid.

0086	Dry run speed	5000

Setting range：0～9999 (mm/min)

0087	The cutting feedrate when power-on	300

Setting range：0～9999 (mm/min)

0088	G0 rapid positioning speed of the 1st axis	5000

Setting range：0～30000 (mm/min)

0089	G0 rapid positioning speed of the 2nd axis	5000

Setting range：0～30000 (mm/min)

0090	G0 rapid positioning speed of the 3rd axis	5000

Setting range：0～30000 (mm/min)

0091	G0 rapid positioning speed of the 4th axis	5000

Setting range：0～30000(mm/min)

0093	Fo speed of rapid override of each axis (for all axes)	30

Setting range：0～1000 (mm/min)

0094	Maximum feedrate during rapid positioning (for all axes)	8000

Setting range：300～30000 (mm/min)

0095	The lowest feedrate during rapid positioning (for all axes)	0

Setting range：0～300 (mm/min)

0096	The maximum control speed during cutting feed (for all axes)	6000

Setting range：300～30000 (mm/min)

0097	The lowest control speed during cutting feed (for all axes)	0

Setting range：0～300(mm/min)

0098	Feedrate during continuous feeding of each axis is JOG mode	2000

Setting range：0～30000 (mm/min)

0099	Speed (FL) when gaining Z pulse signal (for all axes)	40

Setting range：1～60 (mm/min)

0100	Reference point return speed of the 1st axis	4000

Setting range：0～9999 (mm/min)

0101	Reference point return speed of the 2nd axis	4000

Setting range：0～9999 (mm/min)

0102	Reference point return speed of the 3rd axis	4000

Setting range：0～9999 (mm/min)

0103	Reference point return speed of the 4th axis	4000

Setting range：0～9999 (mm/min)

0170	Speed of rapid positioning of the 1st axis in JOG mode	5000

Setting range：0～30000 (mm/min)

0171	Speed of rapid positioning of the 2nd axis in JOG mode	5000

Setting range：0～30000 (mm/min)

0172	Speed of rapid positioning of the 3rd axis in JOG mode	5000

Setting range：0～30000 (mm/min)

0173	Speed of rapid positioning of the 4th axis in JOG mode	5000

Setting range：0～30000 (mm/min)

4.15 Setting Related to Tapping

Position parameter number

0	4	4				PCP	DOV			VGR	

VGR =1: The gear ratio of the spindle and the position encoder can be random.
=0: The gear ratio of the spindle and the position encoder can not be random.

DOV =1: The override is enabled during the rapid tapping retraction.
=0: The override is disabled during the rapid tapping retraction.

PCP =1: The tapping is high velocity deep peck tapping cycle.
=0: The tapping is standard deep peck tapping cycle.

System parameter number

0	4	5				OVS	OVU	TDR		NIZ

NIZ =1: Perform the smooth processing for rigid tapping
=0: Do not perform the smooth processing for rigid tapping

TDR =1: Use the identical time constant when the rigid tapping performs infeed/retraction.
=0: Do not use the identical time constant when the rigid tapping performs infeed/retraction.

OVU =1: Rigid tapping retraction override 10%.
=0: Rigid tapping retraction override 1%.

OVS =1: The feedrate override selection and override cancellation signal in the rigid tapping are enabled.

=0: The feedrate override selection and override cancellation signal in the rigid tapping are enabled.

System parameter number

0 4 6			ORI				SSOG	

SSOG =1: The spindle control mode is servo when the tapping starts.
=0: The spindle control mode is follow when the tapping starts.
ORI =1: The spindle performs the exact stop when tapping starts.
=0: The spindle does not perform the exact stop when tapping starts.

K parameter number

0 0 7	BIT7						

BIT7 =1: Use the spindle position mode.
=0: Use the spindle position mode.
It is set to 1 when using the rigid tapping, and set to 0 when using the flexible tapping.

4.16 Setting the Relative 4th Axis

GSK 990MC owns 4-axis 4-link function.

When the data parameter P5 is set to 4， and after the system is turned off and then turned on, the 4th axis function is valid.

Relevant bit parameters:

System parameter number

0 0 8					AXS4			

AXS4 =1: the 4th axis is set to a rotation axis
=0: the 4th axis is set to a linear axis

System parameter number

0 0 9							A4TP	RAB

RAB =1: rotate nearby when each axis is taken as a rotation axis.
=0: do not rotate nearby when each axis is taken as a rotation axis.
A4TP =1: set to the 4-axis link system.
=0: do not set to the 4-axis link system.

System parameter number

0 5 0		SIM		G90			REL	

REL =1: relative position display setting of indexing table: within 360°.
=0: relative position display setting of indexing table: beyond 360°.
G90 =1: indexing command: absolute command.
=0: indexing command: G90/G91.
SIM =1: an alarm occurs when the indexing code and other controlled axes are in the same block.
=0: no alarm occurs when the indexing code and other controlled axes are in the same block.

Relevant data parameters：

Table 4-16-1

No.	Default value	Setting range	Parameter meaning
0005	3	3~5	CNC's controllable axes
0178	3	0～8	Program name of the 4th axis（0~8：X, Y, Z, A, B, C, U, V, W）

The 4th axis releasing/clamping function

The indexing table clamping/releasing device is controlled by the PLC. When the indexing table clamping/releasing device is started, the corresponding K parameter should be set according to the actual condition. The relevant K parameters are shown below:

Relevant K parameters:

Table 4-16-2

Address	Definition	Default value	Setting value
K014.0	Whether to use the indexing table clamping/releasing device	0（do not use the device）	1（use the device）
K014.1	Whether the table indexing automatically clamps	0（do not automatically clamp/release）	1（automatically clamp/release）
K014.2	Whether the table clamping/releasing has a check switch or not	0（have a check switch）	1（no check switch）
K014.3	The indexing table prohibits the manual MPG single block	0（do not prohibit the manual MPG single block）	1（prohibit the manual MPG single block）
K014.4	Whether to permit moving XYZ axis at the state of the indexing table releasing	0（do not permit moving XYZ axis）	1（permit moving XYZ axis）
K014.5	Whether to turn off the output after the indexing table clamping/ releasing	0（remains the output）	1（turn off the output）
K014.7	The indexing table enters the debugging mode	0（do not enter the debugging mode）	1（do not enter the debugging mode）

1. When the 4th axis has a automatic clamping/releasing function, the system provides two methods to realiz the function:

① Using M code realize the 4th axis clamping/releasing control.

Relevant definitions:

M10 F0312 A axis clamping

M11 F0313 A axis releasing

② After modifying the PLC K14.1=1, the system internal judges the run instruction controlling the 4th axis' clamping/releasing.

Process: execute to A axis command→the system sends F signal，and after the PLC processes the signal, and then outputs Y1.6 to release the table. After the releasing in-position→the system executes A axis movement, and after the A axis instruction execution is completed→the system sends F signal, and after the PLC processes the signal, and then outputs Y1.7 to clamp the table. After the clamping in-position, the system executes the subsequent program.

2. PLC's relevant addresses:

Table 4-16-3

Definition	Diagnosis address	Diaganosis signal	Signal window	Window pin
Indexing table releasing	Y001.6	Diagnosis（Y signal）	XS43	25
Indexing table clamping	Y001.7	Diagnosis（Y signal）	XS43	13
Indexing table releasing check	X002.2	Diagnosis（X signal）	XS41	2
Indexing table clamping check	X002.3	Diagnosis（X signal）	XS41	15

4.17 Setting Related to the Bus Servo

System parameter number

0	0	0			SVCD	SEQ	MSP		INI	INM	PBUS

PBUS =1： The transmission method of driver: bus

=0： The transmission method of driver: pulse

INM =1: The least command increment of a linear axis (inch)

=0： The least command increment of a linear axis (metric)

INI =1： Input unit (inch)

=0： Input unit (metric)

MSP =1: Use a double-spindle control

=0: Do not use a double-spindle control

SEQ =1: Automatically insert a sequence number

=0： Do not automatically insert a sequence number

SVCD =1: Use a bus servo card

=0: Do not use a bus servo card

System parameter number

0	**0**	**1**						**SPT**	**SBUS**	**RASA**

SPT =1: Spindle control type (I/O control)

=0: Spindel control type (frequency conversion or others)

RASA =1: Use the absolute grating rule

=0: Do not use the absolute grating rule

SBUS =1: Spindle driver is the bus control method

=0: Spindle driver is not the bus control method

System parameter number

0	**0**	**5**							**ISC**	

ISC =1: the least command increment：metric 0.0001（mm&deg），inch 0.00001（inch）

=0 the least command increment：metric 0.001（mm&deg），inch 0.0001（inch）

System parameter number

0	**2**	**0**	**UHSM**	**APC**		**USNO**				**ITL**

ITL =1: all-axis interlock is valid

=0： all-axis interlock is invalid

USNO =1: bus servo's older version

=0：bus servo's new version

APC =1: use the absolute encoder

=0: do not use the absolute encoder

UHSM =1: use the manual operation to directly set the machine zero

=0: do not use the manual operation to directly set the machine zero

System parameter number

0	**2**	**1**					**APZ4**	**APZ3**	**APZ2**	**APZ1**

APZ1 =1: the 1st axis' current machine position is set to the machine zero

=0: the 1st axis' current machine position is not set to the machine zero

APZ2 =1: the 2nd axis' current machine position is set to the machine zero

=0: the 2nd axis' current machine position is not set to the machine zero

APZ3 =1: the 3rd axis' current machine position is set to the machine zero

=0: the 3rd axis' current machine position is not set to the machine zero

APZ4 =1: the 4th axis' current machine position is set to the machine zero

=0: the 4th axis' current machine position is not set to the machine zero

Data parameter number

0008	Ethernet bus slave-station MDT data package size	16

Setting range：2，4，6，8，10，12，14，16，20

Note: Never attempt to modify this parameter other than the professionals.

0009	The Max. repeated times of the Ethernet bus	10

Setting range：0~30

Note: Never attempt to modify this parameter other than the professionals.

0380	Set the synchronism axis with the 4th axis 0: Failure to synchronism with any axis 1: X axis 2: Y axis 3: Z axis	0

Setting range：0~3

0381	The Max. permission error between the synchronism axes	200

Setting range：0~10000

0392	The movement distance when the servo optimizes	50

Setting range：0~100

0393	The travel rate when the servo optimizes	2000

Setting range：0~5000

0444	The Max. permission error between the machine coordinate along with each axis and the absolute encoder position	50

Setting range：0~500

0445	Axis 1 configurated with grating accuracy	0.0010

Setting range：0~10

0446	Axis 2 configurated with grating accuracy	0.0010

Setting range：0~10

0447	Axis 3 configurated with grating accuracy	0.0010

Setting range：0~10

0448	Axis 4 configurated with grating accuracy	0.0010

Setting range：0~10

Appendix: Rigid and Flexible Tapping's Setting Method of GSK990MC Matched with DAP03 Spindle Servo Drive Unit

Notes

（1）990MC executing the rigid tapping must be matched with DAP03 Spindle Servo Drive Unit.

（2）990MC executing the rigid tapping must be correctly matched with DAP03 Spindle Servo Drive Unit.

Setting process:

1. Rigid tapping setting: use the paramters defaulted by the system, only the following parameters can be modified:

(1) Bit parameter: NO:46#1 is modified into 1（servo mode）.

(2) PLC parameter: K7#7 is modified into 1（use the spindle position mode）.

(3) Data parameter: P257 tapping's upper limit speed is consistent with that of the spindle's upper limit.

(4) Data parameter: P294 tapping corresponding to the set gear 1 speed is consistent with the upper limit speed.

(5) DAP03 **PA4 is set to** 5.（Speed/Position switch mode）.

(6) When the rigid tapping command is executed, the spindle rotation direction is not consistent with that of the command. DAP03 PA15 is set to 1.

(7) Data parameter: P298 spindle and tapping axis' linear acceleration/deceleration time constant are modified into 300.

(8) Data parameter: when P302 executes the tool retraction, time constants of the spindle and tapping axis are modified into 300.

(9) When the system is switched into the position mode and the spindle speed is not consistent with the command speed, P323 and P326 can be modified, or modifying DAP03 PA12 and PA13 counts the electronic gear ratio according to the formular P*G=N*C*4.

P：Input code's pulse quantity G：electronic gear ratio; N：motor rotation coil quantity；C：photoelectronic encoder line quantity

(10) When the gear ratio between the spindle and the motor is not 1:1，counting the corresponding gear ratio is input into DAP03 PA35, PA36. The system bit parameter No. 44#1 is modified into 1 (the gear ratio between the spindle and the position encoder is set freely), the corresponding gear ratio is input into P286~P288 and P290~P292.

(11) During the rigid tapping, the spindle rotation CW/CCW must be consistent with the tapping screw direction. The speed wave cannot be big, and its error should be within 3 rotations.

(12) It's better to use a screw-type screw tap for cutting soft materials (such as aluminium alloy, copper), with the customized coolant.

2. Flexible tapping setting: two methods to realize the flexible tapping

(1) In position control mode (i.e., **NO:46#1** is modified into 1（position mode）)，**K7#7** is modified into 1（use the spindle position mode)), M03/ M04 is performed to realize the flexible tapping.

(2) In speed control mode（i.e., **NO:46#1 is modified into** 0（speed mode)，**K7#7 is modified into**0（do not use the spindle position mode)), M03/ M04 is performed to realize the flexible tapping. During tapping, after the tapping to the hole bottom is commanded in the program, it is better to pause the time from 1S to 2S.

Note: the above correspondings are the setting methods of machines without gear change

Appendix

Appendix

Appendix

Appendix 1 Ladder Configuration File Format

The signal in configuration file LadChixx.txt of ladder ("xx" corresponds to the running ladder file number set by the system) stores the following information by fixed sequence.

1. F Signals and Meanings of M Code M00---M99

Format: MXX + space + Fyyyy + space + Chinese notes + EOB symbol(enter)

Example: "M00 F0317 program pause"

Thereinto: "xx" from up to down is 00, 01, 02.. till to 99, it totals 100. and its sequence cannot be altered.

Generally, "Space" is one space, which cannot be adulterated by any other characters.

"**yyyy**" means the M code corresponds to F signal value, i.e. **F0317** represents **F31.7**". it may set from 0260 to 0337 (i.e. F signal from 26.0 to 33.7). if it is set to "**-001**" , it means no registration is allowed and it cannot be identified by system.

"Chinese remark" contains up to 32 characters, it may has 16 Chinese characters or equivalent Chinese characters + characters. The following is same as this.

"EOB symbol" means the end of the line and the characters following will not be identified. The following is same as this.

2. "%" that Ccupies a Line Exclusively Means the End of M Code Information Storage.

3. The Codes and Meanings of X Signal X0.0-X6.7

Format: Xxxxx + space + Chinese remark + EOB symbol (enter)

Example: "X0000 the 1st axis limit signal (positive direction with double-switch)"

Thereinto: "xxxx" means the value of X signal, i.e. "0000 for 0.0"，"0067 for 6.7". and it is from 0000 to 0067 from up to down(i.e. X signal from 0.0 to 6.7), its sequence can't be altered.

"Space" generally includes 5 spaces, which cannot be adulterated by any other characters. The following is same as this.

4. The Codes and Meaning of Y Signal Y0.0---Y5.7

Format: Yxxxx + space + Chinese notes + EOB symbol(enter)

Example: "Y0000 lubricating output "

Thereinto: "xxxx" means the value of Y signal, i.e. "0000 for 0.0"，"0057 for 5.7". and it is from 0000 to 0057 from up to down(i.e. Y signal from 0.0 to 5.7), its sequence can't be altered

5. The Codes and Meanings of K Signal Y6.0---Y63.7

Format: Kxxxx + space + Chinese remark + EOB symbol(enter)

Example: "K0060 Whether one limit switch is used or not"

Thereinto : "xxxx" means the value of K signal, i.e. "0060 for 6.0"，"0637 for 63.7". and it is from 0060 to 0637 from up to down(i.e. K signal from 6.0 to 63.7), its sequence can't be altered.

"Space" generally includes 5 spaces, which cannot be adulterated by any other characters.

6. The Codes and Meanings of A Signal A0.0-A31.7A

Format: Axxxx + space + Chinese notes + EOB symbol(enter)

Example: “A0000 air pressure detection abnormality”

Thereinto: “xxxx” means the value of A signal, i.e. “0000 for 0.0”，“0317 for 31.7”. and it is from 0000 to 0317 from up to down(i.e. A signal from 0.0 to 31.7), its sequence can’t be altered.

“Space” generally includes 5 spaces, which cannot be adulterated by any other characters.

7. End // End Sign

Note: Every line of above information should be written in a set form, refer to system embedded file LadChixx.txt for details. The English file LadEngxx.tx**contains 32 English characters or words.**